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MANUFACTURED GAS OPERATIONS

PART OF REPORT ON

ELECTRIC POWER PROGRAM

KINGDOM OF GREECE

FOR

ECONOMIC COOPERATION ADMINISTRATION

WASHINGTON, D. C.

EBASCO SERVICES INCORPORATED
NEW YORK
OCTOBER 1949

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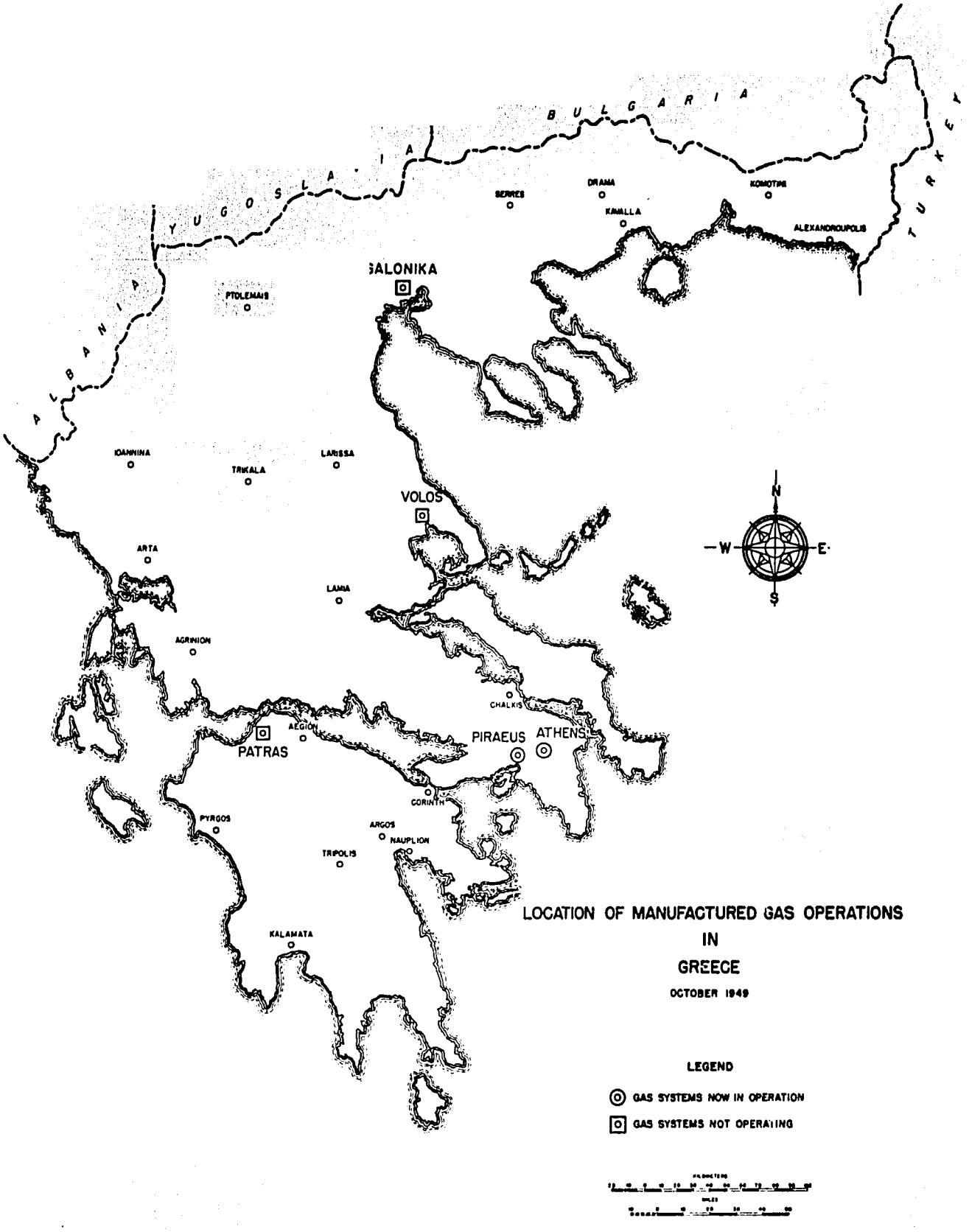


LOCATION OF MANUFACTURED GAS OPERATIONS
IN
GREECE
OCTOBER 1949

I - SUMMARY

A - PURPOSE AND SCOPE

1 - Ebasco-ECA Contract

The Economic Cooperation Administration, Washington D C engaged Ebasco Services Incorporated under Technical Assistance Contract TA-40-1 to conduct field investigations and prepare a report on an Electric Power Program for the Kingdom of Greece.

The scope of the original contract was extended in May 1949 to include an investigation and report on the manufactured gas industry in Greece, which had requested ECA aid for repair and expansion of its facilities. It was considered desirable to examine the needs of the industry, its place in the present Greek economy and its future position when and if lower cost energy becomes available to consumers from the proposed development of the hydroelectric and lignite resources of Greece.

2 - Purpose of Gas Investigations

Although there are important lignite deposits in Greece, a major part of the country's fuel requirements is met by imports of coal, coke, oil and charcoal. For the average consumer, fuel prices are very high, since heavy import taxes are added and passed to the consumer.

The gas industry uses imported bituminous coal to manufacture gas, with coke an important by-product. The industry is subsidized by the Greek government in that it obtains coal at prices below cif (or foreign exchange) cost, at the expense of other users who make up the difference by paying a higher price for their own requirements. It receives further support from the sale of soft coke at prices generally in line with the high prices of other fuels.

The proposed Electric Power Program and the general ECA program for Greece envisions the development of indigenous lignite to reduce Greece's foreign exchange requirements. Development of lignite in briquetted or other form for industry and domestic uses, and the development of the water resources of the country, will result in lowered energy

costs and serious competition to the gas industry which now is able to show a profit only because of favored treatment in an economy tied to high fuel prices.

Gas is now produced and distributed in two cities of Greece - Athens and Piraeus. Plants in Patras and Volos have not operated since 1939 when they were closed because of wartime fuel shortages. A fifth manufactured gas plant at one time operated in Salonika but was abandoned in 1917 after a fire destroyed the city. All of the plants use (or did use) bituminous coal to produce coal-gas, soft coke and tar. In addition, the Athens plant uses a portion of the coke it produces to manufacture blue water-gas. None of the plants can be adapted to manufacture gas from Greek lignite, though existing distribution systems could be utilized for distribution of such gas. All equipment is old with exception of small Otto ovens at Piraeus and Patras.

Ownership, capacity and number of consumers of the several systems is indicated below:

	Capacity		Number of Consumers	Ownership
	m^3/day	Mcf/day		
Athens (1949)	56,000	2,000	24,000	Municipal
Piraeus (1949)	12,500	440	4,000	Private Greek company
Patras (1938)	8,500	300	1,200	Municipal
Salonika (1917)	8,000	280	unknown	Municipal
Volos (1938)	6,000	210	750	Municipal

It is the purpose of this report to examine the gas industry with respect to

a - Operation of, and the economic need for improvement or expansion of present operating facilities at Athens and Piraeus

b - The economic justification of restoring and operating formerly used, but presently idle, facilities at Patras, Volos and Salonika

c - The use of Greek lignite in the manufacture of gas

d - The possible coordination of the present industry with the construction of a by-product coke oven to manufacture metallurgical coke

e - The cost of improving, expanding, restoring or constructing the above-mentioned facilities, and the effect of their operation on Greece's foreign exchange requirements

f - The general economy and application of manufactured gas as a method of distributing energy for essential use

A number of alternate plans for improving, expanding or restoring present facilities or constructing new facilities have been studied and are presented. They include:

a - Athens (Municipal Gas Administration)

Five alternate plans are considered for the improvement and development of present facilities.

Plan A-1. Continuation of present operation with no major improvements or increase of capacity. Improvement of station instrumentation, station metering and consumer metering. Maximum plant capacity - 56,000 m^3/day. Number of consumers - 24,000. Maximum production - 56,000 m^3/day.

Plan A-2. Improvements in Plan A-1 plus installation of new carburetted water-gas set large enough for present needs. Operation of present gas-making equipment discontinued except for emergency. Maximum plant capacity - 57,000 m^3/day. Number of consumers - 24,000. Maximum production - 56,000 m^3/day.

Plan A-3. Improvements in Plan A-1 plus installation of new carburetted water-gas set as in Plan A-2. Half of present coal-gas benches operated for coke production. Maximum plant capacity - 81,600 m^3/day. Number of consumers - 24,000. Maximum production - 56,000 m^3/day.

Plan A-4. Improvements in Plan A-1 plus installation of new carburetted water-gas set as in Plan A-2. Half of present coal-gas

benches operated for coke production. Installation of high-pressure storage stations and enlargement of distribution system. Maximum plant capacity - 81,600 m^3/day. Number of consumers - 27,000. Maximum production - 81,600 m^3/day. Increased production absorbed by new consumers and those now without adequate service.

Plan A-5. Improvements in Plan A-1 plus installation of new carburetted water-gas set as in Plan A-2. Present water-gas sets operated. Installation of high-pressure storage stations. Maximum plant capacity - 77,000 m^3/day. Number of consumers - 24,000. Maximum production - 77,000 m^3/day. Increased production absorbed by present consumers now without adequate service.

b - Piraeus (The Hellenic Town Gas Company Inc)

Three alternate plans are considered for the improvement and development of present facilities.

Plan P-1. Continuation of present operation with no major improvements or increase of capacity. Unmetered consumers provided with meters and changeover from wet- to dry-type consumers' meters initiated. Bomb-damaged gas mains repaired. Maximum plant capacity - 14,600 m^3/day. Number of consumers - 4000. Maximum production - 12,500 m^3/day.

Plan P-2. Improvements in Plan P-1 plus restoration of Otto oven to maximum capacity for better plant efficiency. Improvement of station instrumentation. Maximum plant capacity - 17,700 m^3/day. Number of consumers - 4000. Maximum production - 12,500 m^3/day.

Plan P-3. Improvements in Plan P-2 plus enlargement of distribution system. Maximum plant capacity - 17,700 m^3/day. Number of consumers - 6000. Maximum production - 17,700 m^3/day. Increased production absorbed by 2000 new consumers.

c - Future Supply, Athens - Piraeus

Four alternate plans are considered for the future gas supply of Athens - Piraeus.

Plan AP-1. Execution of Plans A-4 and P-3 and enlargement of distribution facilities. Combined sales increased to maximum. Maximum plant capacity - 121,000 m^3/day. Number of consumers - 42,000. Maximum production - 121,000 m^3/day.

Plan AP-2. Construction of modern by-product coke oven for production of metallurgical coke and gas - underfired with producer gas (for maximum gas production). Present distribution facilities enlarged. Operation of present plants discontinued except for emergency. Maximum plant capacity - 121,000 m^3/day. Number of consumers - 42,000. Maximum production - 121,000 m^3/day. Metallurgical coke available for sale annually - 44,000 metric tons.

Plan AP-3. Construction of modern by-product coke oven for production of metallurgical coke and gas - underfired with oven gas (for maximum coke production). Present distribution facilities enlarged. Operation of present plants discontinued except for emergency. Maximum plant capacity - 121,000 m^3/day. Number of consumers - 42,000. Maximum production - 121,000 m^3/day. Metallurgical coke available for sale annually - 90,000 metric tons.

Plan AP-4. Construction of Lurgi lignite gasification plant (and oxygen plant) to utilize Greek lignite. Present distribution facilities enlarged. Operation of present plants discontinued except for emergency. Maximum plant capacity - 121,000 m^3/day. Number of consumers - 42,000. Maximum production - 121,000 m^3/day.

d - Patras (City of Patras - Gas Department)

Plan B-1. Rehabilitation and operation of plant and distribution system. Maximum plant capacity - 8500 m^3/day. Number of consumers - 2000. Maximum production - 6000 m^3/day.

e - Salonika (City of Salonika - Gas Department)

Plan S-1. Rehabilitation and operation of plant and distribution system.

f - Volos (City of Volos - Gas Department)

Plan V-1. Rehabilitation and operation of plant and distribution system.

B - CONCLUSIONS

1 - Effect of Devaluation of Drachma

At the time this study and report was initiated, the official rate of exchange was 10,000 drachmae per US dollar, and this figure has been used throughout for convenience. It must therefore be used throughout for converting dollars to drachmae.

Devaluation of the drachma to new official rate of 15,000 drachmae per US dollar will have no effect on operating costs as determined or on conclusions reached, provided fuel and new equipment for gas plants are purchased in a country that has similarly devalued its currency.

If fuel is purchased in dollar countries, operating costs will be slightly higher than figures shown in estimates.

Amount of new investment required will be about 33 per cent less than indicated if new equipment is purchased in a country that has similarly devalued its currency. Thus amortization in terms of Greek foreign exchange at 15,000 drachmae per US dollar will be exactly as shown in estimates which are based on purchases in the United States at 10,000 drachmae per US dollar. If purchases of new equipment are made in the United States, amortization requirements in terms of the new drachma rate will be 50 per cent higher and hence operating costs will be a few per cent higher than shown in estimates.

2 - Athens - Piraeus

a - The Athens and Piraeus gas systems are a few kilometers apart but neither system has extra production capacity and there will be no advantage in tying them together physically, at least at this time. However, appreciable savings in administrative and operating expenses should result if the two properties are merged into one operation. Advantages of a single administrative staff, a single accounting and billing office, and a single maintenance crew, and the accompanying reduction in operating expenses and selling price of gas are obvious. It is understood that the present Hellenic Town Gas Company Inc of Piraeus

was an interested participant in prewar negotiations involving the reassignment of the expired Athens franchise.

b - The operating efficiency of both the Athens system and the Piraeus system can be improved by betterment of operating and maintenance methods, elimination of excessive personnel and reduction of unaccounted losses. Savings thus made can be used to help pay for improvements and reduce cost of gas to consumers.

c - The selling price of gas is high because of high fuel costs, relatively inefficient equipment, high unaccounted losses and use of excessive personnel. Reduction in operating expenses can be effected by attention to these details, but generally where new money is required to make improvements, the carrying charges will tend to balance any reduction in unit expense resulting from improved efficiency or higher sales volume. Exception may be made if sales volume is appreciably increased, but in the long term, future fuel prices, lower price of coke and elimination of present coal subsidy will force selling prices to equal or slightly exceed present prices. Thus it can be expected that, barring any subsidy by Greek government, selling prices must necessarily remain high.

d - Notwithstanding its high selling price, present and future, analysis indicates that there will be a continuing limited market for gas because of its convenience to the consumer. However, every effort must be made to reduce cost of gas if it is to maintain its position in the face of increasing competition from electricity and indigenous lignite.

e - Limited additions and improvements to present facilities at Athens and Piraeus can be justified but should be chosen and planned to fit into a long-term program for the area.

Installation of a new carburetted water-gas set and certain other improvements at Athens will permit increased production and improved service to consumers now without adequate service. Savings in operating expense can amortize the investment. Appreciable reduction in Greece's annual foreign exchange requirements can be made by the

gradually increasing use of oil to replace coal - as demand for coke drops with lignite development. The new equipment can be integrated as peaking or spare capacity in any long-term plan ultimately selected for Athens - Piraeus supply.

The restoration of the Otto over at Piraeus to original capacity and efficiency can be effected at relatively low cost. Savings in operating expense and reduction in annual foreign exchange requirements will more than balance the cost of restoration.

f - For future supply of Athens - Piraeus area, choice lies between expansion of present old plants, construction of a modern coke oven plant or construction of a Lurgi lignite gasification plant. None of the projects will result in appreciably cheaper gas but either the modern coke oven plant or the Lurgi plant will effect considerable savings in Greece's annual foreign exchange requirements.

Research will be required on the Greek lignites to determine their characteristics and adaptability to the Lurgi or similar process. Results of pilot plant and other tests, and evaluation of actual costs may indicate that Salonika and other cities of reasonable size can support a gas system supplied by a lignite gasification plant.

3 - Patras

a - Patras plant and distribution system can be rehabilitated and restored to operation but the undertaking does not appear attractive from a business standpoint.

b - The small size of the operation and the relatively high operating and carrying charges would require a sales volume approximately three times as great as in 1938 to permit the selling price of gas to approach present prices prevailing in Athens - Piraeus area. Under present economic conditions, it does not appear that this sales volume can be attained.

4 - Salonika

Facilities abandoned in 1917, small to begin with and seriously deteriorated by time, have no value in any scheme adequate for a city

the size of Salonika. A complete new plant and distribution system would be required, and Salonika might be considered as an alternate location for a modern coke oven plant mentioned for Athens. However, with prospects of development of nearby lignite deposits (Ptolemais and Serres), it appears that Salonika will have its best opportunity to obtain gas when the Lurgi or similar process for utilization of Greek lignite is developed.

5 - Volos

a - Condition of production plant and distribution system precludes rehabilitation at any reasonable cost. An entire new production plant would be required and extensive repairs to the distribution system would be needed to reduce line losses which were excessive in 1938.

b - The high investment required, the limited number of potential consumers and the fact that city has no water system (thereby eliminating the revenue from water heating), make it extremely doubtful that restoration of the present gas system can be justified.

C - RECOMMENDATIONS

1 - Athens - Piraeus

It is recommended that:

a - The Athens and Piraeus properties be merged into one operating organization to obtain the economies resulting from elimination of duplicate high-level supervision and other personnel.

b - Operating efficiency of both the Athens property and the Piraeus property be improved in every way possible. There is opportunity to improve technical supervision, reduce labor costs in operation and maintenance, improve plant instrumentation, reduce system unaccounted losses, and effect savings in accounting procedures.

c - The following improvements and additions are recommended for the Athens system. Total cost is estimated to be $875,000 of which $665,000 is required in foreign exchange.

i - Install new station metering with capacity of 110,000 m^3/day.

ii - Install new carburetted water-gas set to utilize mixed coke, coal and oil and having capacity of 57,000 m^3/day. Accessories include overhead bin and skip hoist, blowers, steam accumulator, waste-heat boiler, steam generating unit, and the necessary piping, fittings, and instrumentation.

iii - Install new electrostatic tar precipitator.

iv - Install new oil storage tank, capacity 100 metric tons.

v - Install new tar distillation apparatus, capacity five metric tons per day.

vi - Provide new instruments for determination of gas analysis, heating value and for pressure and temperature control.

vii - Install three high-pressure storage stations in outlying sections of distribution system.

viii - Install 2000 new consumers' meters, dry type, to initiate changeover to dry-type meters.

d - The following improvements and additions are recommended for the Piraeus system. Total cost is estimated to be $125,000 of which $67,000 is required in foreign exchange.

i - Repair Otto oven and restore to original capacity. Replace missing instruments and gages.

ii - Repair bomb-damaged buildings.

iii - Repair bomb-damaged gas mains.

iv - Install 2000 new consumers' meters; 300 of these are to be used on consumers now unmetered, remainder will allow initiation of changeover to dry-type meters.

e - It is recommended that present plants in Athens - Piraeus be replaced eventually by either a modern coke oven plant or a Lurgi lignite gasification plant. Either scheme will effect appreciable savings in Greek foreign exchange; installation of the coke oven plant will be dictated by a need for metallurgical coke. The Lurgi plant can be installed only when pilot plant and other testing has been accomplished on the Greek lignites to determine their adaptability to the process.

2 - Patras

a - Rehabilitation and operation of the Patras gas plant and distribution system is not recommended.

3 - Salonika

a - Rehabilitation and operation of the former Salonika gas plant and distribution system is not recommended.

4 - Volos

a - Rehabilitation and operation of the Volos gas plant and distribution system is not recommended.

CONVERSION DATA
METRIC AND ENGLISH UNITS

LENGTH

1 inch (in.)	= 25.4 millimeters = 2.54 centimeters = 0.0254 meters
1 foot (ft)	= 30.48 centimeters = 0.3048 meters
1 mile (mi)	= 1609 meters = 1.609 kilometers
1 millimeter (mm)	= 0.03937 inches = 0.003281 feet
1 centimeter (cm)	= 0.3937 inches = 0.03281 feet
1 meter (m)	= 39.37 inches = 3.281 feet
1 kilometer (km)	= 3281 feet = 0.6214 miles

AREA

1 acre	= 4047 square meters (m^2)
1 hectare	= 10,000 square meters = 2.47 acres

VOLUME

1 cubic foot (cu ft)	= 0.02832 cubic meters
1 cubic meter (m^3)	= 35.31 cubic feet
1 Mcf	= 1000 cubic feet = 28.32 cubic meters

WEIGHT

1 pound (lb)	= 0.4536 kilograms
1 kilogram (kg)	= 2.205 pounds
1 short ton	= 2000 pounds = 907.2 kilograms = 0.9072 metric tons
1 metric ton	= 2205 pounds = 1000 kilograms = 1.102 short tons

PRESSURE

1 inch water (in. water) = 25.4 millimeters water
1 millimeter water (mm water) = 0.03937 inches water
1 atmosphere (atm) = 14.696 pounds per square inch = 406.8 inches water = 2.992 inches mercury = 1.033 kilograms per square centimeter

1 pound per square inch (psi) = 0.06804 atmospheres = 0.07031 kilograms per square centimeter = 27.68 inches water

1 kilogram per square centimeter (kg/cm^2) = 0.9678 atmospheres = 14.22 pounds per square inch

ENERGY-HEAT-WORK

1 British thermal unit (Btu) = 0.2520 kilogram-calories = 0.000293 kilowatt-hours
1 kilogram-calorie (kg-cal) = 3.969 British thermal units = 0.001163 kilowatt-hours
1 kilowatt-hour (kwh) = 3413 British thermal units = 860 kilogram-calories
1 therm = 100,000 British thermal units = 25,200 kilogram-calories
1 British thermal unit/cubic foot (Btu/cu ft) = 8.898 kilogram-calories/cubic meter
1 kilogram-calorie/cubic meter ($kg\text{-}cal/m^3$) = 0.1124 British thermal units/cubic foot

II GENERAL DISCUSSION

II - GENERAL DISCUSSION

Important comments and discussions on the individual properties at Athens, Piraeus, Patras, Salonika and Volos are included in Section IV - GAS SYSTEMS and reference should be made to that section.

The following pertinent comments are made to enlarge upon the conclusions and recommendations presented in Section I - SUMMARY.

A - GAS AND ITS IMPORTANCE IN THE GREEK ECONOMY

Greece, for many years, has imported a major part of her fuel requirements in the form of coal, coke, oil and charcoal. The gas industry has played an important part in the nation's economy - while producing gas and a portion of the country's coke requirements, it has provided employment and conserved foreign exchange.

The present maximum hourly gas sendout of the Athens and Piraeus gas plants is 5200 m^3/hour (or 184 Mcf/hour) of mixed gas, which in terms of energy, is equivalent to the hourly output of a 50,000-kw electric generator operating at 50 per cent load factor. The energy is delivered to the consumer at considerable less cost to the Greek economy in foreign exchange than would be the case for the equivalent electric energy produced from imported fuel and at somewhat less cost than if the energy were produced in thousands of separate coal fires.

Coke produced in the Greek gas plants is soft coke, as distinguished from metallurgical coke, and the entire output - about 20,000 metric tons per year - is readily absorbed for use in bakeries, lime kilns, acetylene manufacture, handicraft shops and for domestic purposes.

Thus, although the equipment is old and relatively inefficient and production cost and selling prices of gas are high, the present gas manufacturing facilities have considerable value in the Greek national economy. As indigenous energy resources are developed, the value of the present facilities to the nation's economy will diminish. During this period, the industry will be faced with decreasing revenue from soft coke sales which can be offset in part by increased water-gas production.

The development of Greek lignite and its adaptation for use by home and industry in briquetted or gaseous form will require time. It will probably be many years before large-scale importation of coal and coke can be appreciably reduced so that for a time the gas industry can expect to maintain its present position. It must, however, look forward and be prepared to make the changes and adjustments required by development of indigenous resources - otherwise it will either fail completely or, depending on government subsidy, will be reduced to serving only those consumers whose income permits or whose special needs require the use of expensive gas.

The tabulation on page 19 shows the present selling price of gas compared with electricity and other fuels for the Athens - Piraeus area.

B - RATES

In Athens and Piraeus, flat rates are charged for gas regardless of minimum use or load factor. Industrial and commercial consumers are charged higher rates than residential consumers on the theory that industry can better afford to pay - just the opposite of practice in the United States where industrial and commercial consumers obtain the lower rates that are justified by greater use and higher load factors.

Recommendation has not been made that rate practices be changed, but any long-range plan for the gas industry should include such consideration.

C - IMPROVEMENT OF ATHENS MUNICIPAL GAS SYSTEM

Recommended improvements for the Athens property include improved station metering and instrumentation; a new carburetted water-gas set having a capacity of 57,000 m^3/day; electrostatic tar precipitator to keep tar out of gas mains and meters; tar distillation apparatus to remove moisture from by-product tar; three high-pressure storage stations for outlying sections of distribution system and a number of dry-type meters to initiate gradual replacement of present wet-type consumers' meters.

Improvements are discussed in more detail in Plan A-5, Section III and in Section IV, Paragraph A-3. Plan A-5 was studied for the effect of all water-gas production, but actually any combination of old and new equipment can be used to take advantage of prices of coal, coke and oil, and effect savings in foreign exchange.

Present conditions in the Athens system are such that maximum production capacity has been reached and most of the production is absorbed by consumers near the plant. Distribution pressures are very low in the outlying sections with result that, though there are many connected consumers in these areas, they consume little or no gas. Pressure of gas leaving plant cannot be increased because of the wet-type consumers' meters. The high-pressure storage stations will correct this condition, storing gas in off-peak hours and feeding it back into the distribution mains when the demand occurs. It is contemplated that additional consumers will not be added to the system until a long-term plan is adopted for the Athens - Piraeus area.

The modern carburetted water-gas set provides additional capacity at low cost to meet present conditions. All new equipment can be integrated as peaking or spare capacity in any future plan for supplying Athens - Piraeus area.

Total new investment is estimated to be $875,000 of which $665,000 is required in foreign exchange. Annual foreign exchange requirements for fuel can be reduced by as much as $200,000, depending on the proportion of water-gas produced - such reduction can generally be expected to exceed the $70,000 required annually for carrying charges on new equipment. Selling price of gas must necessarily remain high to amortize the new investment.

D - IMPROVEMENT OF PIRAEUS GAS SYSTEM

Recommended improvements include repair and restoration of Otto oven to original capacity, improvement of plant instrumentation, repair of buildings and gas mains damaged by bombing, and the provision of a quantity of dry-type consumer's meters. These latter items are to be used for consumers not now metered and to initiate a gradual change

to dry-type meters. Improvements are discussed in more detail in Plan P-2, Section III and in Section IV, Paragraph B-3. It is contemplated that additional consumers will not be added to the system until a long-term plan is adopted for the Athens - Piraeus area.

The efficient and modern Otto oven cannot be operated at maximum capacity because of damage incurred as a result of wartime shortage of skilled labor. By restoring it to maximum capacity, the less efficient horizontal retorts can be operated at lower load factor. This will result in decreased fuel consumption and lessened labor charges.

Total new investment is estimated to be $125,000 of which $67,000 is required in foreign exchange. About $24,000 less foreign exchange will be required annually for fuel, which exceeds the $7000 required annually for carrying charges on new equipment. Under present fuel price conditions, selling price of gas can be slightly under present price.

E - FUTURE SUPPLY OF ATHENS - PIRAEUS

The greatest opportunity in the manufacture of gas to effect appreciable savings in Greek foreign exchange lies in (1) local manufacture of metallurgical coke which would otherwise be imported and (2) utilization of Greek lignite by Lurgi or similar process. Either project could be used as a basis for economical future supply of Athens - Piraeus or other large cities.

1 - By-Product Coke Oven

Metallurgical coke is not produced in Greece. In 1938, 18,000 metric tons of high-grade metallurgical coke were imported for use by foundries and other industries having metallurgical requirements. In 1948, 15,000 metric tons were imported and approximately 18,000 metric tons will be imported in 1949. The Greek Ministry of Transport estimates that 40,000 - 50,000 metric tons will be required annually by 1951 - 1952 when reconstruction gets under way and that 80,000 metric tons will be needed annually when economic conditions become normal.

Production of metallurgical coke in Greece forms the basis of Plan AP-2 (new investment - $6,725,000) and Plan AP-3 (new investment - $7,075,000); these plans are included to show the possibilities of a by-product coke oven in Greece.

Plan AP-2 makes 44,000 metric tons of metallurgical coke available annually while Plan AP-3 makes 90,000 metric tons available annually. Either plan will produce 75 per cent more gas than is now consumed in the Athens - Piraeus area and number of consumers can be increased from present 28,000 to 42,000. Plans include new distribution facilities for these additional consumers.

2 - Utilization of Greek Lignite

Processes for utilizing low-grade fuels, such as the Lurgi process, are relatively new and most of the experience has been gained in prewar Germany. Before such a process could be utilized in Greece, considerable research would have to be carried out on the respective Greek lignites to determine their characteristics and suitability. A pilot plant would probably be required either in the United States or Greece or arrangements might be made to test the Greek lignites in Germany.

Plan AP-4 (new investment - $5,075,000) is based on the Lurgi or equivalent process and is included to show its possibilities in long-term saving of foreign exchange. Plan includes a Lurgi plant with capacity to supply Athens - Piraeus with 75 per cent more gas than is now consumed in the area and the total number of consumers is increased from the present 28,000 to 42,000. Plan includes additional distribution facilities for the new consumers.

F - RESTORATION OF PATRAS GAS SYSTEM

Patras plant and distribution system can be restored and operated but it will require $175,000 to rehabilitate a property that has a present value of $110,000 and which will have a value of possibly $285,000 if restored to operation. Because of the small size of the operation and the relatively high operating and carrying charges, selling

price of gas will be about 25 per cent higher than for Athens - Piraeus, or higher if less than 2000 consumers will subscribe.

In 1938 Patras had a population of 79,000 persons and there were 1135 consumers subscribing to the use of gas. Average annual use per consumer was 388 m^3. The average selling price of gas was 0.6 that of its equivalent in electric energy, and 3.0 to 4.0 times its equivalent in wood and charcoal. Based on present prices of electricity, wood and charcoal, gas at \$0.13/m^3 or \$3.70/Mcf would find a comparable market.

In the analysis made under Plan B-1 Section III, it is determined that consumption must average 652 m^3 for each of 2000 consumers for gas to be produced and sold at a figure approaching that given above. This is nearly three times the sales volume obtaining in 1938 and it is questionable that such sales volume can be attained under existing conditions.

G - RESTORATION OF SALONIKA GAS SYSTEM

Abandoned in 1917, nothing remains of the former production plant except the site, and those portions of the distribution system that remain are worthless. Since restoration is impossible, no cost estimate has been prepared for Plan S-1.

H - RESTORATION OF VOLOS GAS SYSTEM

As a result of the war, very little remains of the production plant equipment. Condition of distribution system is questionable. Since restoration is not considered to be practical or economical, no cost estimate has been prepared for Plan V-1.

APPROXIMATE COST OF FUELS FOR RESIDENTIAL COOKING, ATHENS-PIRAEUS AREA JUNE 1949

	Unit Cost*		Cost on Basis of Lower Heating Value	
	Drachmae	Equivalent Dollars	Drachmae per kg-cal	Equivalent Dollars per Therm
Gas-Athens	1020 drach/m^3	$2.89/Mcf	0.27	0.67
Gas-Piraeus	1045 drach/m^3	$2.95/Mcf	0.28	0.68
Electricity-Athens-Piraeus	230 drach/kwh	$0.023/kwh	0.27	0.67
Kerosene	2700 drach/liter	$1.02/gal	0.23	0.56
Gasoline	2700 drach/liter	$1.02/gal	0.22	0.55
Wood	545 drach/kg	$0.025/lb	0.18	0.45
Charcoal	940 drach/kg	$0.043/lb	0.15	0.39
Coke	780 drach/kg	$0.035/lb	0.12	0.30
Coal	780 drach/kg	$0.035/lb	0.10	0.25
Lignite	390 drach/kg	$0.018/lb	0.10	0.25

Notes: Approximate rate of exchange - $1 = 10,000 drachmae

1 therm = 100,000 Btu

* All items bear taxes reflecting difficult postwar conditions. Electric rate is special incremental tariff, but carries fuel adjustment.

III ALTERNATE PLANS OF DEVELOPMENT

III - ALTERNATE PLANS OF DEVELOPMENT

A - GENERAL

A number of plans are considered in this section for the improvement, expansion, or restoration of present facilities or for the provision of new facilities for gas supply. The plans generally are based on those improvements discussed in Section IV, with additional consideration of gas production from Greek lignite or in connection with large-scale manufacture of coke for foundry or other metallurgical use in Greece. A study is made to determine the approximate new money required, approximate prices at which gas must be sold and the effect of each plan on Greece's annual foreign exchange requirements. A number of assumptions are made as discussed below. If other values or costs apply, the effect of a given change can be determined by following through the tabulations.

In calculating operating expenses attendant upon, and foreign exchange balance resulting from, operation of gas plants in Greece, it is necessary to assume certain figures for the cif values of raw materials delivered in Greek harbors and to assume other figures for the internal value of raw materials and products when landed and distributed in Greece. The cif value represents the amount of Greek foreign exchange which must be available to bring the material to Greece. The corresponding internal values must be used to determine operating expenses and hence the selling price of gas.

It is very difficult to predict what the future will bring in world fuel prices and such prediction is beyond the scope of the present report. However, for comparison and study, some assumptions must be made - in this report it is assumed that (1) world fuel prices will drop slightly from present levels; (2) price of Greek lignite will drop appreciably because of large-scale development and (3) Greek internal prices for imported fuels will drop due to the influence of world market conditions and the development of Greek lignite.

In the tabulations following are shown approximate present price levels of pertinent raw materials and products and probable future price levels of the same materials when conditions of (2) and (3) above are fulfilled. Probable future levels include elimination of present coal subsidy.

Approximate Cif Values for Computing Foreign Exchange Balance (in US Dollars or Equivalent at 10,000 Drachmae/Dollar)		
	Present Price Levels Dollars/Metric Ton	Probable Future Price Levels Dollars/Metric Ton
Coal	20.00	17.50
Soft Coke	26.50	22.50
Metallurgical Coke	26.50	22.50
Heavy Oil	24.00	20.00
Tar	25.00	20.00
Ammonia	150.00	125.00
Benzol	60.00	50.00

Approximate Internal Values for Computing Operating Expenses (in US Dollars or Equivalent at 10,000 Drachmae/Dollar)		
	Present Price Levels Dollars/Metric Ton	Probable Future Price Levels Dollars/Metric Ton
Purchase by Gas Company		
Coal	16.00 (incl subsidy)	19.50 (no subsidy)
Coke	30.00	25.00
Heavy Oil	27.00	23.00
Lignite	6.00	6.00
Sale by Gas Company		
Soft Coke	37.00	30.00
Metallurgical Coke	37.00	30.00
Tar	50.00	25.00
Ammonia	175.00	150.00
Benzol	75.00	65.00

In the plan detail sheets, pages 27-28, 32-33, 38-39 and 42, only present price levels are used for illustration. However, the plan summaries, pages 26, 31, 37 and 41, and the text of this section, contain additional figures derived from the use of the probable future price levels in computing operating expenses and foreign exchange balances.

Estimated production expenses are based on present employment levels and wage scales.

Approximate new investment required is expressed in foreign exchange in US dollars and local expenditures in equivalent US dollars (10,000 drachmae/dollor). Estimates are based on costs in effect in the United States as of August 1949 for apparatus and services, with construction costs modified to apply to Greece. The costs reflect the estimated charges for field engineering, design engineering, equipment and materials, purchasing, ocean freight, construction labor, supervision, contingencies and fees.

Annual carrying charges are assumed to be 12 per cent which includes 9.5 per cent for amortization in 17 years at 6 per cent interest, and an allowance of 2.5 per cent for taxes, insurance, etc. The foreign exchange component of annual carrying charges is taken to be 10.5 per cent, which includes 9.5 per cent for amortization and 1 per cent for insurance - it is assumed that new construction will be insured in US dollars.

No money is allowed for depreciation or renewal of new equipment as it is considered that allotted maintenance expenses will be sufficient to keep equipment in good condition during the amortization period. However, in figuring the total annual expense on summary sheets, 5 per cent of estimated value of present old equipment is allowed to set up a renewal fund for eventual replacement of old equipment.

In computing the average gas selling price required under each plan, it is assumed that present sales taxes, averaging about 8 per cent, will be continued. The average selling price is expanded in the present ratio of residential and industrial consumption and rates to obtain the estimated residential and industrial rates which must be charged if all expenses are to be met.

B - MUNICIPAL GAS ADMINISTRATION - ATHENS
Alternate Plans for Development of Present Facilities

Five plans are considered for the improvement and development of present facilities. These plans are shown in detail on pages 27-28 and in summarized form on page 26.

Plan A-1 is the continuation of present operation with no major improvements except for new station metering, new instrumentation for gas production equipment and 2000 new consumers' meters. Plan assumes that there will be no additional consumers and no increase in demand over that experienced in 1948 - 1949. Improved metering and instrumentation will lay proper foundation for accounting of raw materials and products, which is essential if the enterprise is to be operated at improved efficiency. The plan requires $65,000 in new money of which $56,000 is in foreign exchange. For present fuel prices, average selling price of gas will be about the same as at present and foreign exchange required annually will amount to $688,000 for fuel and $6000 for carrying charges on new investment. For probable future fuel prices, average selling price of gas must be about 20 per cent higher than at present though foreign exchange required annually for fuel will drop to $622,000.

Plan A-2 contemplates installation of a new nine-foot carburetted water-gas set to operate on mixed coal, coke and oil, complete with accessory apparatus, and having sufficient capacity to carry present demand. Present equipment is relegated to standby status. The plan assumes that there will be no additional consumers and no increase in demand over that experienced in 1948 - 1949. The improvements of Plan A-1 are included and, in addition there are included a new electrostatic tar precipitator and new tar distillation apparatus. A small storage tank for heavy oil is provided and it is assumed that deliveries of oil can be obtained as needed either from government petroleum pool or from Athens Piraeus Electricity Company storage. The plan requires $750,000 in new money of which $570,000 is in foreign exchange. For present fuel prices and for probable future fuel prices, average selling price of gas will have to be about 10 per cent higher than now to amortize the new

investment. Foreign exchange required annually will amount to $327,000 for fuel at present fuel prices and $278,000 at probable future fuel prices, plus $60,000 for carrying charges on new investment. This is $270,000 to $300,000 less than for Plan A-1, but no coke is produced.

Plan A-3 is the same as Plan A-2 except that in addition to operating the new carburetted water-gas set, 20 benches of present coal-gas equipment are operated for coke production - some for sale and some for use in the new gas set. Improvements and additions are the same as for Plan A-2. The plan requires same new money as Plan A-2, i e $750,000 of which $570,000 is in foreign exchange. For present fuel prices, average selling price of gas will have to be about 5 per cent more than at present and foreign exchange required annually will amount to $735,000 for fuel and $60,000 for carrying charges on new investment. For probable future fuel prices, average selling price of gas will have to be about 20 per cent more than at present, and foreign exchange required annually for fuel will drop to $642,000.

Plan A-4 is the same as Plan A-3 except that 3000 new consumers are served and new lines and services are provided to serve them. Three high-pressure storage stations are provided in the outlying areas to boost delivery pressure. Other additional equipment added over that of Plan A-3 is a new washer cooler to supplement present condensing capacity at production plant. It is estimated that the new maximum day and new annual sales will be 50 per cent greater than at present. The plan requires $1,525,000 in new money, of which $1,120,000 is in foreign exchange. Under present fuel price levels and because of increased sales, average selling price of gas can be reduced about 20 per cent below price now existing. Foreign exchange required annually amounts to $883,000 for fuel and $118,000 for carrying charges on new investment - total is slightly less than 50 per cent greater than for Plan A-1. For probable future fuel prices, average selling price of gas can be about 10 per cent less than at present and foreign exchange required annually for fuel will drop to $767,000.

Plan A-5 assumes the operation of only the old water-gas sets and new carburetted water-gas set to supply a new maximum demand and new

annual sales volume 40 per cent greater than at present. No additional consumers are served as it is estimated that the present poorly served districts will absorb the additional volume of gas. Plan includes new station metering, new instruments for gas production, 2000 new consumers' meters, new carburetted water-gas set with all accessories, electrostatic tar precipitator, tar distillation apparatus, and three high-pressure storage stations for the outlying areas. No new lines and services are provided. The plan requires $875,000 in new money, of which $665,000 is in foreign exchange. For present fuel prices and for probable future fuel prices, and because of increased sales, average selling price of gas can be reduced about 10 per cent below price now existing. Foreign exchange required annually will amount to $469,000 for fuel at present fuel prices and $395,000 at probable future fuel prices plus $70,000 for carrying charges on new investment. This is $143,000 to $155,000 less than for Plan A-1 and 40 per cent more gas is made available. However, no coke is produced.

MUNICIPAL GAS ADMINISTRATION - ATHENS GREECE
ALTERNATE PLANS FOR DEVELOPMENT OF PRESENT FACILITIES
SUMMARY

Plan No.	A-1	A-2	A-3	A-4	A-5
Max Plant Capacity - m^3/day	56,000	57,000	81,600	81,600	77,000
Production - Max Day - m^3/day	56,000	56,000	56,000	81,600	77,000
Annual Gas Sales - 1000 m^3	13,200	13,200	13,200	20,800	18,300
Annual Sales Soft Coke - metric tons	12,900	0	14,500	14,100	0
Total New Investment - $1000	65	750	750	1,525	875
For Present Fuel Price Levels					
Annual Expenses - $1000					
Operating	1,218	1,254	1,183	1,385	1,414
Annual Charges on New Investment	8	90	90	183	105
Renewal of Present Property	125	125	125	125	125
Total	1,351	1,478	1,398	1,693	1,644
Total Annual Expense - $/$m^3$ sold	0.103	0.112	0.106	0.081	0.090
Estimated Sales Tax (Av 8%) - $/$m^3$	0.008	0.009	0.009	0.008	0.007
Approx Required Av Selling Price - $/$m^3$	0.111	0.121	0.114	0.089	0.097
Estimated Residential Rate - $/$m^3$	0.105	0.114	0.108	0.085	0.092
Estimated Residential Rate - $/Mcf	2.96	3.23	3.06	2.39	2.60
Estimated Industrial Rate - $/$m^3$	0.146	0.158	0.150	0.117	0.127
Estimated Industrial Rate - $/Mcf	4.13	4.49	4.25	3.31	3.60
Annual Foreign Exchange - $1000					
Debits for Raw Materials	688	327	735	883	469
Debits for Annual Charges on New Investment	6	60	60	118	70
Total	694	387	795	1,001	539
Credits for Products	(645)	(328)	(713)	(895)	(447)
For Probable Future Fuel Price Levels					
Annual Expenses - $1000					
Operating	1,449	1,271	1,379	1,592	1,443
Annual Charges on New Investment	8	90	90	183	105
Renewal of Present Property	125	125	125	125	125
Total	1,582	1,486	1,594	1,900	1,673
Total Annual Expense - $/$m^3$ sold	0.120	0.113	0.121	0.091	0.091
Estimated Sales Tax (Av 8%) - $/$m^3$	0.010	0.009	0.010	0.007	0.007
Approx Required Av Selling Price - $/$m^3$	0.130	0.122	0.131	0.098	0.098
Estimated Residential Rate - $/$m^3$	0.123	0.115	0.124	0.093	0.093
Estimated Residential Rate - $/Mcf	3.48	3.26	3.51	2.63	2.63
Estimated Industrial Rate - $/$m^3$	0.171	0.159	0.172	0.128	0.128
Estimated Industrial Rate - $/Mcf	4.84	4.50	4.87	3.62	3.62
Annual Foreign Exchange - $1000					
Debits for Raw Materials	602	278	642	767	395
Debits for Annual Charges on New Investment	6	60	60	118	70
Total	608	338	702	885	465
Credits for Products	(555)	(285)	(612)	(768)	(389)

MUNICIPAL GAS ADMINISTRATION
ATHENS GREECE
ALTERNATE PLANS FOR DEVELOPMENT OF PRESENT FACILITIES
ESTIMATED OPERATING EXPENSE AND NEW INVESTMENT
APPROXIMATE FOREIGN EXCHANGE BALANCE

	Plan A-1	Plan A-2	Plan A-3	Plan A-4	Plan A-5	
	Continue Present Operation with No Major Improvements Maximum Capacity as Actually Obtained in 1948 - 1949	Discontinue Operation of Present Coal Gas Benches and Water-Gas Sets. Install New 9-Ft Carburetted Water-Gas Set to Operate on Mixed Coal, Coke and Oil. Maximum Capacity Same as Present	Operate an Average of 20 Benches for Coal Gas and Coke Production - Install New 9-Ft Carburetted Water-Gas Set to Operate on Mixed Coal, Coke and Oil. Present Max Day	New Max Day-50% Greater Than Present Max Day	Discontinue Operation of Coal Gas Benches - Operate Old and New Water-Gas Sets. Maximum Day About 40% Greater than Present Maximum Day	
Maximum Plant Capacity - m^3/day - Coal gas	36,000 (30 benches)	24,600 (used for emergency only)	24,600 (used for emergency only)	24,600 (used for emergency only)	24,600 (used for emergency only)	
Water gas	20,000	20,000	20,000	20,000	20,000	
Carburetted water gas	-	57,000	57,000	57,000	57,000	
Total - Mixed gas at 4200 kg-cal/m^3	56,000	57,000	81,600	81,600	77,000	
Plant Production - Maximum Day - m^3/day	56,000	56,000	56,000	81,600	77,000	
Annual Production at 76% Load Factor - m^3 - Coal gas	9,500,000	0	9,000,000	9,000,000	0	
Water gas	6,000,000	0	0	0	4,500,000	
Carburetted water gas	-	15,500,000	6,500,000	15,500,000	17,000,000	
Total - Mixed gas	15,500,000	15,500,000	15,500,000	24,500,000	21,500,000	
Annual Sales Assuming 15% Unaccounted Gas - m^3	13,200,000	13,200,000	13,200,000	20,800,000	18,300,000	
Coal Gas Manufacture - Annual Quantities						
Coal required for carbonizing - metric tons	33,000		31,000	31,000		
Coal used for boiler fuel - metric tons	400		700	700		
Coke produced - metric tons	21,400		20,100	20,100		
Coke used for boiler fuel - metric tons	300		0	0		
Coke used for bench fuel - metric tons	5,000		4,700	4,700		
Coke used for water gas manufacture - metric tons	3,200		900	1,300		
Coke available for sale - metric tons	12,900		14,500	14,100		
Tar produced - metric tons	1,150		1,100	1,100		
Tar used for bench fuel - metric tons	850		0	0		
Tar available for sale - metric tons	300		1,100	1,100		
Water Gas Manufacture - Annual Quantities					Old Sets	New Sets
Coal required for boiler fuel - metric tons	1,000	2,300	1,100	2,400	800	2,800
Coal required for generator fuel - metric tons	-	3,800	2,500	3,700	-	4,100
Coke required for generator fuel - metric tons	3,200	1,300	900	1,300	3,200	1,400
Oil (heavy) - metric tons	-	7,100	1,200	5,300	-	7,800
Tar produced (all available for sale) - metric tons	-	1,300	240	1,100	0	1,500
Approximate Annual Operating Expense						
Production						
Coal gas						
Salaries	$ 75,000	-	$ 72,000	$ 45,000	-	
Labor	132,000	-	124,000	124,000	-	
Coal carbonized at $16.00/metric ton	528,000	-	496,000	496,000	-	
Boiler fuel (coal at $16.00/metric ton, coke at $37.00/metric ton)	18,000	-	11,000	11,000	-	
Bench fuel (coke at $37.00/metric ton)	185,000	-	193,000	193,000	-	
Miscellaneous	23,000	-	21,000	21,000	-	
Maintenance	43,000	-	41,000	41,000	-	
	$1,004,000	-	$ 958,000	$ 931,000	-	
Net residual credit from by-products (coke at $37.00, tar at $50.00/metric ton)	(807,000)	-	(759,000)	(759,000)	-	
Coal gas production expense	$ 197,000	-	$ 199,000	$ 172,000	-	

Water gas										
Salaries	$ 48,000		$ 123,000		$ 51,000		$ 78,000		$ 123,000	
Labor	30,000		55,000		23,000		55,000		82,000	
Generator fuel (coal at $16.00, imported coke at $30.00, local coke at $37.00/metric ton)	118,000		100,000		73,000		107,000		184,000	
Oil at $27.00/metric ton	-		192,000		32,000		143,000		211,000	
Boiler fuel (coal at $16.00/metric ton)	16,000		37,000		18,000		38,000		58,000	
Miscellaneous	5,000		11,000		5,000		11,000		15,000	
Maintenance	19,000		16,000		9,000		16,000		28,000	
	$ 236,000		$ 534,000		$ 211,000		$ 448,000		$ 701,000	
Net residual credit from by-products (tar at $50.00/metric ton)	-		(65,000)		(12,000)		(55,000)		(75,000)	
Water gas production expense	$ 236,000		$ 469,000		$ 199,000		$ 393,000		$ 626,000	
Storage	9,000	Per m³ Produced	9,000	Per m³ Produced	9,000	Per m³ Produced	9,000	Per m³ Produced	9,000	Per m³ Produced
Total production expense	$ 442,000	$0.0285	$ 478,000	$0.0308	$ 407,000	$0.0262	$ 574,000	$0.0234	$ 635,000	$0.0295
( ) indicates credit		Per m³ Sold		Per m³ Sold		Per m³ Sold		Per m³ Sold		Per m³ Sold
Total production expense		$0.0335		$0.0362		$0.0308		$0.0276		$0.0347
Distribution	320,000	$0.0212	$ 280,000	$0.0212	$ 280,000	$0.0212	$ 315,000	$0.0151	$ 283,000	$0.0155
General and Administrative Expense	$ 496,000	$0.0376	$ 496,000	$0.0376	$ 496,000	$0.0376	$ 496,000	$0.0238	$ 496,000	$0.0271
Total Operating Expense	$1,258,000	$0.0923	$1,254,000	$0.0950	$1,183,000	$0.0896	$1,385,000	$0.0665	$1,414,000	$0.0773
Approximate New Investment	Foreign Exchange	Drachmae	Foreign Exchange	Drachmae	Foreign Exchange	Drachmae	Foreign Exchange	Drachmae	Foreign Exchange	Drachmae
Production Plant										
New station meter - 110,000 m³/day	$ 4,400	$1,000	$ 4,400	$ 1,000	$ 4,400	$ 1,000	$ 4,400	$ 1,000	$ 4,400	$ 1,000
Relocate 30,000 m³/day meter to measure water gas		1,000								
New 9-ft carb water gas set - 57,000 m³/day			106,000	36,000	106,000	36,000	106,000	36,000	106,000	36,000
New overhead bin and ship hoist			37,000	12,000	37,000	12,000	37,000	12,000	37,000	12,000
New blowers, one steam, one motor driven, with accessories			66,000	8,000	66,000	8,000	66,000	8,000	66,000	8,000
New steam accumulator and accessories			10,000	2,500	10,000	2,500	10,000	2,500	10,000	2,500
New waste-heat boiler, 2.25 metric tons/hr at 10 atm sat			41,000	5,000	41,000	5,000	41,000	5,000	41,000	5,000
New steam generating unit 9 metric tons/hr at 10 atm sat			68,000	23,000	68,000	23,000	68,000	23,000	68,000	23,000
New building for steam generating unit				8,000		8,000		8,000		8,000
New piping, fittings and miscellaneous items			21,000	21,000	21,000	21,000	21,000	21,000	21,000	21,000
New electrostatic tar precipitator			9,000	2,500	9,000	2,500	9,000	2,500	9,000	2,500
New oil storage tank - 100 metric tons, with pump, heater and piping			3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
New tar distillation apparatus			37,000	12,000	37,000	12,000	37,000	12,000	37,000	12,000
New instruments for gas analysis, heating value, pressure and temp control	5,600	1,000	5,600	1,000	5,600	1,000	5,600	1,000	5,600	1,000
New washer cooler							18,000	7,000		
Distribution System										
New - three high pressure storage stations							83,000	25,000	83,000	25,000
New - 2000 consumers meters, dry type	40,000	4,000	40,000	4,000	40,000	4,000			40,000	4,000
New - 5000 consumers meters, dry type							100,000	10,000		
New lines and services							310,000	150,000		
	$ 50,000	$7,000	$ 448,000	$139,000	$ 448,000	$139,000	$ 919,000	$327,000	$ 531,000	$164,000
Engineering, etc	6,000	2,000	122,000	41,000	122,000	41,000	201,000	78,000	134,000	46,000
	$ 56,000	$9,000	$ 570,000	$180,000	$ 570,000	$180,000	$1,120,000	$405,000	$ 665,000	$210,000
Annual Charges	5,900	1,900	60,000	30,000	60,000	30,000	118,000	65,000	70,000	35,000
Total New Investment	$65,000		$750,000		$750,000		$1,525,000		$875,000	
Foreign Exchange Balance of Raw Materials and Products										
Based on Cif Value - June 1949			( ) indicates credit							
Debits - Coal at $20.00/metric ton	$ 688,000		$ 122,000		$ 706,000		$ 756,000		$ 154,000	
Heavy oil at $24.00/metric ton	-		170,500		29,000		127,000		187,000	
Coke at $26.50/metric ton	-		34,500		-		-		128,000	
Total	$ 688,000		$ 327,000		$ 735,000		$ 883,000		$ 469,000	
Credits - Coke at $26.50/metric ton	($ 341,500)		-		($ 384,000)		($ 374,000)		-	
Tar at $25.00/metric ton	(7,500)		($ 32,000)		(33,000)		(55,000)		($ 37,000)	
Gas (sold) (coal equivalent at $20.00/metric ton)	(296,000)		(296,000)		(296,000)		(466,000)		(410,000)	
Total	($ 645,000)		($ 328,000)		($ 713,000)		($ 895,000)		($ 447,000)	
Net foreign exchange required after credit for cif value of products	$ 43,000		($ 1,000)		$ 22,000		($ 12,000)		$ 22,000	

C - THE HELLENIC TOWN GAS COMPANY INC - PIRAEUS -
Alternate Plans of Development of Present Facilities

Three plans are considered for the improvement and development of present facilities. These plans are shown in detail on pages 32-33 and in summarized form on page 31.

Plan P-1 is the continuation of present operation with no major improvements except the repair of bomb-damaged gas mains, and provision of 1000 new consumers' meters. Plan assumes that there will be no additional consumers and no increase in demand over that experienced in 1948. Provision of meters will allow proper accounting of gas and will permit high unaccounted losses to be cut down. The plan requires $35,000 in new money of which $26,000 is in foreign exchange. For present fuel prices, average selling price of gas can be slightly under that now existing and foreign exchange required annually will amount to $167,000 for fuel and $3000 for carrying charges on new investment. For probable future fuel prices, average selling price of gas must be about 15 per cent higher than at present and foreign exchange required annually for fuel will drop to $146,000.

Plan P-2 contemplates restoration of Otto oven to original capacity for better plant efficiency. Plan assumes that there will be no additional consumers and no increase in demand over that experienced in 1948. Improvements include repair of bomb-damaged gas mains, 2000 new consumers' meters, repair of the Otto oven, repair of the bomb-damaged buildings in the production plant, and replacement of missing instruments and gages. The plan requires $125,000 in new money of which $67,000 is in foreign exchange. For present fuel prices, average selling price of gas can be slightly under that now existing and foreign exchange required annually will amount to $139,000 for fuel and $7000 for carrying charges on new investment. This is a reduction of $24,000 over Plan P-1 in annual foreign exchange, and results from better efficiency of Otto oven. For probable future fuel prices, average selling price of gas must be about 15 per cent higher than at present and foreign exchange required for fuel will drop to $122,000.

Plan P-3 contemplates restoration of Otto oven to original capacity for better plant efficiency. The distribution system is enlarged and the plant is operated up to its new maximum capacity. Annual sales are approximately 40 per cent greater than for Plan P-1 or P-2. In addition to the improvements included in Plan P-2, new lines and services are provided for 2000 new consumers, and additional condenser, naphthalene and ammonia scrubbers and purifiers are provided in the production plant. The plan requires $315,000 in new money of which $136,000 is in foreign exchange. For present fuel prices, because of increased sales and better efficiency of Otto oven, average selling price of gas can be about 20 per cent lower than at present. Foreign exchange required annually amounts to $241,000 for fuel and $15,000 for carrying charges on new investment. For probable future fuel prices, average selling price of gas must be about 5 per cent higher than at present, and foreign exchange required annually for fuel will drop to $212,000. The fairly large increase in fuel required under this plan is due to the relatively low efficiency of the horizontal retorts. It would be impractical to operate the horizontal retorts as much as required in this plan, and the plan is undesirable.

THE HELLENIC TOWN GAS COMPANY INC - PIRAEUS GREECE
ALTERNATE PLANS FOR DEVELOPMENT OF PRESENT FACILITIES
SUMMARY

Plan No.	P-1	P-2	P-3
Max Plant Capacity - m^3/day	14,600	17,700	17,700
Production - Max Day - m^3/day	12,500	12,500	17,700
Annual Gas Sales - 1000 m^3	3,071	3,071	4,338
Annual Sales Soft Coke - metric tons	4,200	3,500	6,000
Total New Investment - $1000	35	125	315
For Present Fuel Price Level			
Annual Expenses - $1000			
Operating	245	239	283
Annual Charges on New Investment	4	15	38
Renewal of Present Property	40	40	40
Total	289	294	361
Total Annual Expense - $/$m^3$ sold	0.094	0.095	0.083
Estimated Sales Tax (Av 8%) - $/$m^3$	0.008	0.008	0.007
Approx Required Av Selling Price - $/$m^3$	0.102	0.103	0.090
Estimated Residential Rate - $/$m^3$	0.091	0.091	0.079
Estimated Residential Rate - $/Mcf	2.58	2.58	2.24
Estimated Industrial Rate - $/$m^3$	0.127	0.127	0.110
Estimated Industrial Rate - $/Mcf	3.60	3.60	3.11
Annual Foreign Exchange - $1000			
Debits for Raw Materials	167	139	241
Debits for Annual Charges on New Investment	3	7	15
Total	170	146	256
Credits for Products	(185)	(167)	(267)
For Probable Future Fuel Price Levels			
Annual Expenses - $1000			
Operating	310	293	373
Annual Charges on New Investment	4	15	38
Renewal of Present Property	40	40	40
Total	354	348	455
Total Annual Expense - $/$m^3$ sold	0.115	0.113	0.105
Estimated Sales Tax (Av 8%) - $/$m^3$	0.009	0.009	0.008
Approx Required Av Selling Price - $/$m^3$	0.124	0.122	0.113
Estimated Residential Rate - $/$m^3$	0.115	0.113	0.099
Estimated Residential Rate - $/Mcf	3.26	3.20	2.80
Estimated Industrial Rate - $/$m^3$	0.154	0.150	0.138
Estimated Industrial Rate - $/Mcf	4.36	4.25	3.91
Annual Foreign Exchange - $1000			
Debits for Raw Materials	146	122	212
Debits for Annual Charges on New Investment	3	7	15
Total	149	129	227
Credits for Products	(159)	(143)	(228)

THE HELLENIC TOWN GAS COMPANY INC
PIRAEUS GREECE
ALTERNATE PLANS FOR DEVELOPMENT OF PRESENT FACILITIES
ESTIMATED OPERATING EXPENSE AND NEW INVESTMENT
APPROXIMATE FOREIGN EXCHANGE BALANCE

	Plan P-1 Continue Present Operation with No Major Improvements Maximum Capacity as Actually Obtained in 1948	Plan P-2 Restore Otto Oven to Original Capacity for Better Efficiency - Sell Same Amount of Gas as in 1948	Plan P-3 Restore Otto Oven to Original Capacity - Enlarge Distribution System for More Customers - Operate Plant at New Maximum Capacity
Maximum Plant Capacity - m^3/day - Coal gas from Otto oven	7,200	10,300	10,300
- Coal gas from horizontal retorts (6 benches)	7,400	7,400	7,400
- Total - @ 4200 kg-cal/m^3	14,600	17,700	17,700
Plant Production - Maximum Day - m^3/day	12,500	12,500	17,700
Annual Production @ 79% Load Factor - m^3 - Otto oven	2,628,000	3,527,000	3,527,000
- Horizontal retorts	985,000	86,000	1,576,000
- Total	3,613,000	3,613,000	5,103,000
Annual Sales Assuming 15% Unaccounted Gas - m^3	3,071,000	3,071,000	4,338,000
Coal Gas Manufacture - Annual Quantities			
Otto Oven			
Coal carbonized - metric tons	4,960	6,660	6,660
Coke produced - metric tons	3,220	4,330	4,330
Coke used for bench fuel - metric tons	750	1,000	1,000
Coke available for sale - metric tons	2,470	3,330	3,330
Tar produced - metric tons	150	200	200
Horizontal Retorts			
Coal carbonized - metric tons	3,370	300	5,400
Coke produced - metric tons	2,190	200	3,510
Coke used for bench fuel - metric tons	510	50	810
Coke available for sale - metric tons	1,680	150	2,700
Tar produced - metric tons	100	10	160
Approximate Annual Operating Expense			
Production			
Otto Oven			
Salaries	$ 8,200	$ 15,000	$ 11,500
Labor	30,000	42,000	42,000
Coal carbonized @ $16.00/metric ton	79,400	106,600	106,600
Bench fuel - coke @ $37.00/metric ton	27,800	37,000	37,000
Miscellaneous	1,400	1,800	1,800
Maintenance	8,400	12,000	12,000
Horizontal Retorts			
Salaries	8,200	1,400	4,900
Labor	25,300	2,500	35,000
Coal carbonized @ $16.00/metric ton	54,000	4,800	86,400
Bench fuel - coke @ $37.00/metric ton	18,900	1,900	30,000
Miscellaneous	1,500	500	2,100
Maintenance	5,800	2,000	9,000
Exhausters, purifiers, etc	7,800	8,000	11,000
	$276,700	$235,500	$389,300

Net residual credit from by-products (coke @ $37.00, tar @ $50.00/metric ton)	(205,000)		(170,100)		(297,000)	
( ) indicates credit						
Storage	$ 71,700	Per m^3 Produced	$ 65,400	Per m^3 Produced	$ 92,300	Per m^3 Produced
	2,700		2,700		2,700	
Total Production Expense	$ 74,400	$0.0206	$ 68,100	$0.0188	$ 95,000	$0.0186
		Per m^3 Sold		Per m^3 Sold		Per m^3 Sold
Total Production Expense		$0.0242		$0.0222		$0.0219
Distribution	$ 35,600	$0.0116	$ 35,600	$0.0116	$ 53,200	$0.0123
General and Administrative Expense	$135,200	$0.0440	$135,200	$0.0440	$135,200	$0.0312
Total Operating Expense	$245,200	$0.0798	$238,900	$0.0778	$283,400	$0.0654
Approximate New Investment	Foreign Exchange	Drachmae	Foreign Exchange	Drachmae	Foreign Exchange	Drachmae
Production Plant						
Repair Otto oven (materials valued at $30,000 are on hand but held for duty and warehouse charges)						
Duty				$ 8,000		$ 8,000
Warehousing and handling				7,000		7,000
Erection			$ 6,000	7,000	$ 6,000	7,000
Miscellaneous				2,000		2,000
Replace missing instruments and gages			3,000	1,000	3,000	1,000
Repair buildings				13,000		13,000
Additional condenser, piping, etc					3,600	1,600
Additional naphthalene scrubber, piping, etc					800	3,200
Additional ammonia scrubber, piping, etc					800	3,200
Additional purifiers, piping, etc					800	5,000
Distribution System						
Repair mains	$ 3,000	$ 5,000	$ 3,000	$ 5,000	$ 3,000	$ 5,000
New - 1000 customers meters, dry type	20,000	2,000				
New - 2000 customers meters, dry type			40,000	4,000	40,000	4,000
New lines and services for 2000 new consumers					53,000	80,000
	$ 23,000	$ 7,000	$ 52,000	$47,000	$111,000	$140,000
Engineering, Etc	3,000	2,000	15,000	11,000	25,000	39,000
	$ 26,000	$ 9,000	$ 67,000	$58,000	$136,000	$179,000
Annual Charges	$ 2,700	$ 1,500	$ 7,000	$ 8,000	$ 15,000	$ 23,000
Total New Investment	$ 35,000		$125,000		$315,000	
Annual Foreign Exchange Balance of Raw Materials and Products - Based on cif value - June 1949			( ) indicates credit			
Debits - Coal @ $20.00/metric ton	$167,000		$139,000		$241,000	
Credits - Coke @ $26.50/metric ton	(110,000)		(93,000)		(161,000)	
- Tar @ $25.00/metric ton	(6,000)		(5,000)		(9,000)	
- Gas (sold) (coal equivalent at $20.00/metric ton)	(69,000)		(69,000)		(97,000)	
- Total	($185,000)		($167,000)		($267,000)	
Net foreign exchange required after credit for cif value of products	($ 18,000)		($ 28,000)		($ 26,000)	

D - ATHENS AND PIRAEUS COMBINED
Alternate Plans for Future Gas Supply

Four plans are considered for the future gas supply of Athens - Piraeus. These plans are shown in detail on pages 38-39, and in summarized form on page 37. All plans provide for a maximum day of 121,000 m^3, with annual production of 34,000,000 m^3. Heating value of 4000 kg-cal/m^3 has been used in the comparison as this is the maximum heating value obtainable with the Lurgi process for utilizing lignite.

Plan AP-1 is set up principally as a basis of comparison for plans involving a modern by-product coke oven plant and a Lurgi lignite gasification plant. It embraces the development of the present Athens system under Plan A-4 and the present Piraeus system under Plan P-3, with additional facilities to distribute about 75 per cent more gas than is now sold in the two cities. Plan requires $2,950,000 in new money, of which $1,970,000 is in foreign exchange. For present fuel prices, and because of increased sales and present high internal value of coke, average selling price of gas can be about 20 per cent lower than at present. Foreign exchange required annually will amount to $1,178,000 for fuel and $207,000 for carrying charges on new investment. For probable future fuel prices, average selling price of gas can be only about 5 per cent under present price. Foreign exchange required annually for fuel will drop to $1,026,000.

Plan AP-2 contemplates construction of a modern by-product coke oven plant near Athens to produce coke and supply Athens - Piraeus with gas. Coke ovens are underfired with producer gas and 44,000 tons of metallurgical coke are available for sale annually. Sufficient additional distribution facilities are added to make the combined system equal to that considered in Plan AP-1. Plan requires $6,725,000 in new money, of which $5,110,000 is in foreign exchange. For present fuel prices, and because of increased gas sales and present high internal price of coke, average selling price of gas can be about 25 per cent lower than at present. Foreign exchange required annually amounts to $1,500,000 for fuel and $537,000 for carrying charges on new investment.

about the same as at present. Foreign exchange required annually for fuel will drop to $1,313,000. For the amortization period, the plan shows an advantage in annual foreign exchange requirements over Plan AP-1 amounting to $35,000 per year at present fuel prices and a disadvantage of $34,000 per year at possible future fuel prices. This assumes that metallurgical coke will be imported if not manufactured in Greece. After amortization of new coke oven plant there will be an additional gain of about $500,000 annually.

Plan AP-3 is similar to Plan AP-2 except that coke ovens are underfired with coke oven gas and 90,000 metric tons of metallurgical coke are available for sale annually. Plan requires $7,075,000 in new money of which $5,370,000 is in foreign exchange. For present fuel prices and because of increased gas sales and high selling price of coke, average selling price of gas can be about 50 per cent lower than now. Foreign exchange required annually amounts to $2,460,000 for fuel and $564,000 for carrying charges on new investment. For probable future fuel prices, average selling price of gas can be about 10 per cent lower than at present. Foreign exchange required annually for fuel will drop to $2,153,000. For the amortization period, the plan shows an advantage in annual foreign exchange over Plan AP-1 amounting to $356,000 per year at present fuel prices and an advantage of $207,000 per year at possible future fuel prices. This assumes that metallurgical coke will be imported if not manufactured in Greece. After amortization of new coke oven plant, there will be an additional gain of about $500,000 annually.

Plan AP-4 contemplates construction of a Lurgi lignite gasification plant near Athens to supply Athens - Piraeus with gas. Plan requires $5,075,000 in new money of which $3,692,000 is in foreign exchange. Foreign exchange required annually amounts to zero dollars for fuel and $388,000 for carrying charges on new investment. Increased gas sales are offset by absence of coke for sale with the result that selling price of gas can be about 20 per cent lower than at present. Average selling price will remain fairly constant with changes in world fuel prices as changes in the price of benzol and tar will have relatively small effect. The plan shows an advantage in annual foreign exchange over Plan AP-1

amounting to $508,000 for present fuel price levels and an advantage of $430,000 at possible future fuel prices - assuming that soft coke produced under Plan AP-1 can be replaced with indigenous lignite. After amortization of the Lurgi plant, there will be an additional gain of about $400,000 annually.

ATHENS AND PIRAEUS COMBINED
ALTERNATE PLANS FOR FUTURE GAS SUPPLY
SUMMARY

Plan No.	AP-1	AP-2	AP-3	AP-4
Max Plant Capacity - m^3/day	121,000	121,000	121,000	121,000
Production - Max Day - m^3/day	121,000	121,000	121,000	121,000
Annual Gas Sales - 1000 m^3	28,900	28,900	28,900	28,900
Annual Sales Soft Coke - metric tons	20,700	-	-	-
Annual Sales Metallurgical Coke - metric tons	-	44,000	90,000	-
Total New Investment - $1000	2,950	6,725	7,075	5,075
For Present Fuel Price Levels				
Annual Expenses - $1000				
Operating	1,879	1,177	432	1,689
Annual Charges on New Investment	354	807	849	609
Renewal of Present Property	165	115	115	115
Total	2,398	2,099	1,396	2,413
Total Annual Expense - $/$m^3$ sold	0.083	0.073	0.048	0.084
Estimated Sales Tax (Av 8%) - $/$m^3$	0.007	0.006	0.004	0.007
Approx Required Av Selling Price - $/$m^3$	0.090	0.079	0.052	0.091
Estimated Residential Rate - $/$m^3$	0.084	0.074	0.049	0.085
Estimated Residential Rate - $/Mcf	2.39	2.09	1.39	2.40
Estimated Industrial Rate - $/$m^3$	0.118	0.103	0.068	0.118
Estimated Industrial Rate - $/Mcf	3.33	2.91	1.94	3.35
Annual Foreign Exchange - $1000				
Debits for Raw Materials	1,178	1,500	2,460	-
Debits for Annual Charges on New Investment	207	537	564	388
Total	1,385	2,037	3,024	388
Credits for Products	(1,238)	(1,925)	(3,233)	(749)
For Probable Future Fuel Price Levels				
Annual Expense - $1000				
Operating	2,202	1,836	1,637	1,768
Annual Charges on New Investment	354	807	847	609
Renewal of Present Property	165	115	115	115
Total	2,721	2,758	2,599	2,492
Total Annual Expense - $/$m^3$ sold	0.094	0.095	0.090	0.086
Estimated Sales Tax (Av 8%) - $/$m^3$	0.008	0.008	0.007	0.007
Approx Required Av Selling Price - $/$m^3$	0.102	0.103	0.097	0.093
Estimated Residential Rate - $/$m^3$	0.095	0.096	0.091	0.087
Estimated Residential Rate - $/Mcf	2.69	2.72	2.58	2.46
Estimated Industrial Rate - $/$m^3$	0.134	0.135	0.127	0.121
Estimated Industrial Rate - $/Mcf	3.79	3.82	3.60	3.43
Annual Foreign Exchange - $1000				
Debits for Raw Materials	1,026	1,313	2,153	-
Debits for Annual Charges on New Investment	207	537	564	388
Total	1,233	1,850	2,717	388
Credits for Products	(1,063)	(1,646)	(2,754)	(648)

ATHENS AND PIRAEUS COMBINED
ALTERNATE PLANS FOR FUTURE GAS SUPPLY
ESTIMATE OF OPERATING EXPENSE AND NEW INVESTMENT
APPROXIMATE FOREIGN EXCHANGE BALANCE

	Plan AP-1 Expand Athens Municipal System, Plan A-4. Expand Hellenic Town System, Plan P-3. Operate Both Plants at Outputs Up to Maximum Capacity. (Data for the Two Systems Have Been Totalled.)	Plan AP-2 Construct Modern By-product Coke Oven Plant Near Athens to Supply Athens-Piraeus. Underfire with Producer Gas	Plan AP-3 Construct Modern By-product Coke Oven Plant Near Athens to Supply Athens-Piraeus. Underfire with Coke-oven Gas	Plan AP-4 Construct Lurgi Gasification Plant Near Athens to Utilize Greek Lignite and Supply Athens-Piraeus with Gas
Maximum Plant Capacity - m^3/day - Coal gas	42,300	121,000	121,000	-
- Water gas	20,000	-	-	-
- Carburetted water gas	58,700	-	-	-
- Lurgi process gas	-	-	-	121,000
- Total gas @ 4000 kg-cal/m^3	121,000	121,000	121,000	121,000
Plant Production - Maximum Day - m^3/day	121,000	121,000	121,000	121,000
Annual Production @ 76% Load Factor - m^3 - Coal gas	14,103,000	34,000,000	34,000,000	-
- Water gas	3,900,000	-	-	-
- Carburetted water gas	15,997,000	-	-	-
- Lurgi process gas	-	-	-	34,000,000
- Total gas	34,000,000	34,000,000	34,000,000	34,000,000
Annual Sales Assuming 15% Unaccounted Gas - m^3	28,900,000	28,900,000	28,900,000	28,900,000
Coal Gas Manufacture - Annual Quantities				
Coal carbonized - metric tons	43,000	75,000	123,000	
Coal used for boiler fuel - metric tons	700			
Soft coke produced - metric tons	27,900			
Soft coke used for bench fuel - metric tons	6,500			
Soft coke used for water gas manufacture - metric tons	1,700			
Soft coke available for sale - metric tons	20,700			
Metallurgical coke produced - metric tons	-	56,000	92,000	
Metallurgical coke used for bench fuel - metric tons	-	12,000	2,000	
Metallurgical coke available for sale - metric tons	-	44,000	90,000	
Tar produced - metric tons	1,800	3,100	5,100	
Ammonia produced - metric tons		200	300	
Benzol produced - metric tons	-	600	1,000	
Water Gas or Lurgi Gas Manufacture - Annual Quantities				
Coal required for boiler fuel - metric tons	3,200			
Lignite required for boiler fuel - metric tons				11,000
Coal required for generator fuel - metric tons	5,300			
Coke required for generator fuel - metric tons	1,700			
Lignite required for generator fuel - metric tons				58,000
Oil (heavy) - metric tons	5,600			
Tar produced - metric tons	1,100			2,700
Benzol produced - metric tons				1,100
Approximate Annual Operating Expense				
Production				
Coal Gas				
Salaries	$ 54,000	$ 139,000	$ 139,000	
Coal carbonized @ $16.00/metric ton	689,000	1,200,000	1,968,000	
Oven and retort operation	570,000	525,000	861,000	
	$1,313,000	$1,864,000	$2,968,000	
Net residual credit from by-products (tar @ $50.00, coke @ $37.00, ammonia @ $175.00 and benzol @ $75.00/metric ton	(1,056,000)	(1,863,000)	(3,712,000)	
	$ 257,000	$ 1,000	($ 744,000)	

( ) indicates credit

Water Gas (or Lurgi Gas)								
Salaries	$ 85,000						$ 139,000	
Labor	71,000						84,000	
Generator fuel - coal @ $16.00, coke @ $37.00/metric ton	148,000							
Generator fuel - lignite @ $6.00/metric ton	-							
Oil (heavy) @ $27.00/metric ton	151,000						349,000	
Boiler fuel - coal @ $16.00/metric ton	51,000							
Boiler fuel - lignite @ $6.00/metric ton	-							
Maintenance	21,000						66,000	
Power	-						60,000	
Miscellaneous	14,000						72,000	
	$ 541,000						-	
Net residual credit from by-products (tar @ $50.00, benzol @ $75.00/metric ton)	(55,000)						$ 770,000	
	$ 486,000						(217,000)	
Storage	12,000						$ 553,000	
Total production expense	$ 755,000	Per m³ Produced $0.0222	12,000	Per m³ Produced $0.0004	12,000	Per m³ Produced ($0.0215)	12,000	Per m³ Produced $0.0166
			$ 13,000		($ 732,000)		$ 565,000	
Total production expense		Per m³ Sold $0.0261		Per m³ Sold $0.0005		Per m³ Sold ($0.0253)		Per m³ Sold $0.0195
Distribution	$ 493,000	$0.0171	$ 533,000	$0.0184	$ 533,000	$0.0184	$ 493,000	$0.0171
General and Administrative Expense	$ 631,000	$0.0218	$ 631,000	$0.0218	$ 631,000	$0.0218	$ 631,000	$0.0218
Total Operating Expense	$1,879,000	$0.0650	$1,177,000	$0.0407	$ 432,000	$0.0149	$1,689,000	$0.0584
Approximate New Investment	Foreign Exchange	Drachmae	Foreign Exchange	Drachmae	Foreign Exchange	Drachmae	Foreign Exchange	Drachmae
Improvement of present Athens Municipal Gas System (See Plan A-4)	$ 919,000	$327,000						
Improvement of present Hellenic Town Gas Company System (See Plan P-3)	111,000	140,000						
Construction of by-product coke oven plant near Athens								
Land and improvement				$ 45,000		$ 45,000		
Plant			$2,800,000	650,000	$3,000,000	720,000		
Compressor station			50,000	12,000	50,000	12,000		
Pipelines to Athens and Piraeus			120,000	83,000	120,000	83,000		
Construction of Lurgi Lignite Gasification Plant near Athens								
Land and improvement								$ 45,000
Plant							$1,750,000	480,000
Pipelines and reducing stations to serve Athens and Piraeus								
Additional distribution facilities	550,000	320,000	1,000,000	480,000	1,000,000	480,000	120,000	83,000
	$1,580,000	$787,000	$3,970,000	$1,270,000	$4,170,000	$1,340,000	1,000,000	480,000
Engineering, etc	390,000	193,000	1,140,000	345,000	1,200,000	365,000	$2,870,000	$1,088,000
	$1,970,000	$980,000	$5,110,000	$1,615,000	$5,370,000	$1,705,000	822,000	295,000
Annual Charges	207,000	147,000	537,000	270,000	564,000	285,000	$3,692,000	$1,383,000
Total New Investment	$2,950,000		$6,725,000		$7,075,000		388,000	221,000
							$5,075,000	
Foreign Exchange Balance of Raw Materials and Products - Based on Cif Value - June 1949								
Debits - Coal @ $20.00/metric ton	$1,044,000		$1,500,000		$2,460,000			
- Heavy oil @ $24.00/metric ton	134,000		-		-			
- Total	$1,178,000		$1,500,000		$2,460,000		( ) indicates credit	
Credits - Coke @ $26.50/metric ton	($ 549,000)		($1,166,000)		($2,385,000)			
- Tar @ $25.00/metric ton	(73,000)		(77,000)		(127,000)		($ 67,000)	
- Ammonia @ $150.00/metric ton	-		(30,000)		(45,000)		-	
- Benzol @ $60.00/metric ton	-		(36,000)		(60,000)		(66,000)	
- Gas (sold) (coal equivalent @ $20.00/metric ton)	(616,000)		(616,000)		(616,000)		(616,000)	
- Total	($1,238,000)		($1,925,000)		($3,233,000)		($ 749,000)	
Net foreign exchange required after credit for cif value of products	($ 60,000)		($ 425,000)		($ 773,000)		($ 749,000)	

E - CITY OF PATRAS - GAS DEPARTMENT -
Plan for Restoration of Facilities

Plan B-1 is shown in detail on page 42, and in summarized form on page 41.

Plan assumes that 2000 consumers will be served. New investment includes repair of Otto oven, new exhausters, new condenser, new station meter, new station governor, repairs to gas holder, coal pier and track and buildings, repairs to 1200 services, installation of 600 new services, 1800 new meters and miscellaneous repairs to gas mains.

Plan requires $175,000 in new money of which $93,000 is in foreign exchange. Approximately 1800 metric tons of coke will be available annually for sale in the area. For present fuel prices the average selling price of gas must be about 10 per cent higher than present Athens - Piraeus price. Foreign exchange required annually will amount to $72,000 for fuel and $9000 for carrying charges on new investment. For probable future fuel prices, average selling price of gas must be about 30 per cent higher than present Athens - Piraeus price. Foreign exchange required annually for fuel will drop to $62,000.

CITY OF PATRAS GREECE - GAS DEPARTMENT
PLAN FOR RESTORATION OF FACILITIES
SUMMARY

Max Plant Capacity - m^3/day	8,500
Production - Max Day - m^3/day	6,000
Annual Gas Sales - 1000 m^3	1,304
Annual Sales Soft Coke - metric tons	1,790
Total New Investment - $1000	175

	For Present Fuel Price Levels	For Probable Future Fuel Price Levels
Annual Expenses - $1000		
Operating	113	138
Annual Charges on New Investment	21	21
Renewal of Present Property	9	9
Total	143	168
Total Annual Expense - $/$m^3$ sold	0.110	0.129
Estimated Sales Tax (Av 8%) - $/$m^3$	0.009	0.010
Approx Required Av Selling Price - $/$m^3$	0.119	0.139
Estimated Residential Rate - $/$m^3$	0.106	0.124
Estimated Residential Rate - $/Mcf	3.00	3.51
Estimated Industrial Rate - $/$m^3$	0.148	0.173
Estimated Industrial Rate - $/Mcf	4.19	4.90
Annual Foreign Exchange - $1000		
Debits for Raw Materials	72	62
Debits for Annual Charges on New Investment	9	9
Total	81	71
Credits for Products	(79)	68)

CITY OF PATRAS GREECE - GAS DEPARTMENT
PLAN FOR RESTORATION OF FACILITIES
ESTIMATED OPERATING EXPENSE AND NEW INVESTMENT
APPROXIMATE FOREIGN EXCHANGE BALANCE

	Plan B-1 Restore Facilities and Operate for Gas Production Max Day - 6000 m^3	
Maximum Plant Capacity - m^3/day - Coal gas from Otto oven	3,600	
Coal gas from horizontal retorts (4 benches)	4,900	
Total - @ 4200 kg-cal/m^3	8,500	
Assume 2000 consumers out of population of 87,000, and yearly sales of 652 m^3/consumer (23 Mcf)		
Annual Sales - m^3	1,304,000	
Annual Production - m^3 (assuming 20% unaccounted)	1,630,000	
Plant Production - Maximum Day - m^3 (assuming 75% load factor)	6,000	
Annual Production - m^3 - Otto oven	1,304,000	
Horizontal retorts	326,000	
Total	1,630,000	
Coal Gas Manufacture - Annual Quantities		
Otto Oven		
Coal carbonized - metric tons	2,460	
Coke produced - metric tons	1,600	
Coke used for bench fuel - metric tons	370	
Coke available for sale - metric tons	1,230	
Tar produced - metric tons	70	
Horizontal Retorts		
Coal carbonized - metric tons	1,120	
Coke produced - metric tons	730	
Coke used for bench fuel - metric tons	170	
Coke available for sale - metric tons	560	
Tar produced - metric tons	30	
Approximate Annual Operating Expense		
Production		
Salaries and labor	$ 40,000	
Coal carbonized @ $16.00/metric ton	57,300	
Bench fuel (coke @ $37.00/metric ton)	20,000	
Maintenance	11,000	
Miscellaneous	3,000	
( ) indicates credit		
Net residual credit from by-products (coke @ $37.00, tar @ $50.00/metric ton)	$131,300	Per m^3 Produced
Total Production Expense	(88,700)	
	$ 42,600	$0.0261
		Per m^3 Sold
Total Production Expense		$0.0327
Distribution	$ 25,000	$0.0192
General and Administrative Expense	$ 45,000	$0.0345
Total Operating Expense	$112,600	$0.0864

Approximate New Investment	Foreign Exchange	Drachmae
Production Plant		
New - motor, cable and instruments for Otto oven	$ 4,200	$ 4,000
Repair horizontal retorts	1,700	3,000
New - two exhausters	4,200	800
New - one condenser	1,700	800
New - one station meter	1,700	400
New - one station governor	800	400
Piping and connections for new equipment	1,700	3,300
Repair gas holder		800
New - coal pier and track		10,000
Repair buildings		2,500
Miscellaneous	4,000	4,000
Distribution System		
Repair 1200 services	$ 3,500	$17,000
Install 600 new services	2,500	12,000
New - 1800 consumers meters - dry type	36,000	
Install 1800 new meters		7,500
Miscellaneous gas main repairs		4,500
	$ 62,000	$71,000
Engineering, etc	20,000	22,000
	$ 82,000	$93,000
Annual Charges	$ 8,600	$12,400
Total New Investment	$175,000	

Annual Foreign Exchange Balance of Raw Materials and Products - Based on Cif Values - June 1949	
Debits - Coal @ $20.00/metric ton	$ 72,000
Credits - Coke @ $26.50/metric ton	(47,000)
Tar @ $25.00/metric ton	(2,500)
Gas (sold) (coal equivalent @ $20.00/metric ton) ( ) indicates credit	(29,500)
Total	($ 79,000)
Net foreign exchange required after credit for cif value of products	($ 7,000)

IV. GAS SYSTEMS

IV - GAS SYSTEMS

A - MUNICIPAL GAS ADMINISTRATION - ATHENS

1 - General

The gas production plant and distribution system in the city of Athens were established and built up by private interests beginning about 1870. The franchise of the private company expired in October 1939 and property ownership reverted to the Town Hall of Athens without cost. Since that time, the property has been operated as a municipal enterprise. Production plant and distribution system were regarded as entirely written off and present book value is based only on improvements and additions made since 1939 (see balance sheet on page 62). Though the property is old and in poor condition, resulting in part from the exigencies of war, its present value is estimated to be in excess of $2,000,000. To replace the entire property with modern equipment would probably cost $6,000,000.

Since the present operation is municipal, it is not subject to property taxes, income taxes or customs duties on fuel, stores and equipment. Sales taxes of seven per cent on residential gas, ten per cent on industrial gas and ten per cent on coke and tar are collected for the government. A welfare tax of one per cent is also collected on industrial gas sales.

The enterprise is subsidized by the government to the extent that it obtains coal at prices below cif cost, at expense of other coal users who make up difference by paying a higher price for their own requirements. It receives further support from sale of coke at prices generally in line with high prices of other fuels. Any further support needed to bring revenues in line with expenses is obtained by adding a special charge per cubic meter of gas sold.

Due to prevailing economic conditions, number of employees exceeds the number actually required for operation. This is offset in part by the general low level of wages paid. Payments to insurance, pension and social security funds amount to 25-30 per cent of payroll.

In general, all operating costs - production, distribution and administration - are much higher than for similar operation in the United States. Net production costs are somewhat in line with United States practice but are in line only because of the coal subsidy and the high selling price of coke. Factors tending to lower the operating costs (and hence the selling price of gas) are (1) absence of appreciable amortization charges, (2) governmental subsidy of coal price, and (3) high selling price of coke and tar. Factors tending to raise operating costs (and hence the selling price of gas) are (1) high price paid for coal which, even with the subsidy, is about 50 per cent higher than a United States gas company would pay, (2) high labor, distribution and administration expense, which includes military security, (3) operating condition and relative low efficiency of the gas production equipment, (4) relatively low sales per consumer, and (5) high unaccounted losses. The net result of all these factors is that gas must be sold at very high rates - two to three times as high as rates for a similar sized operation in the United States.

Flat rates are charged regardless of minimum use or load factor. Industrial and commercial consumers are charged higher rates than residential consumers on the theory that industry can better afford to pay - just the opposite of practice in the United States where industrial and commercial consumers obtain the lower rates that are justified by greater use and higher load factors.

The following schedule of rates was in effect in June 1949:

Residential Gas (Including Public Services) - For Cooking, Water Heating, Small Amount of Space Heating			
	Drachmae/m^3	$/$m^3$	$/Mcf
Base Price	800.00	0.800	2.265
Special Charge for Fuel Adjustment - 10%	80.00	0.080	0.227
Sales Tax - 7%	61.20	0.061	0.173
Meter Rental	80.00	0.080	0.227
	1021.20	$1.021	$2.892
All monthly bills carry stamp tax of 200 drachmae or $0.02.			

Commercial Gas (and Industrial) - for Coffee Shops, Pastry Shops, Bakeries, Printing Industry, Manufacture of Boxes, Glassware, Ceramics, Electric Lamp Bulbs, Etc			
	Drachmae/m^3	$/$m^3$	$/Mcf
Base Price	1100.00	1.100	3.115
Special Charge for Fuel Adjustment - 10%	110.00	0.110	0.312
Sales Tax - 10%	121.00	0.121	0.343
Welfare Tax - 1%	12.10	0.012	0.034
Meter Rental	80.00	0.080	0.227
	1423.10	$1.423	$4.031
All monthly bills carry stamp tax of 200 drachmae or $0.02.			

Operating revenue and expense data for 12 months ending March 31 1949 are shown on pages 63, 64 and 65. Sales tax collections are not included. Taxes equivalent to $15,000 (150,000,000 drachmae) shown at end of expense sheet, represent appropriation taxes to which all industry is subject. The amount of $300,074 shown as net from operation is 20 per cent of gross revenue. Approximately 60 per cent of the amount has been allocated for working capital, improvements and additions.

Details of operation for 12 months ending March 31 1949 are shown on page 63 and additional annual operating data are given on pages 58 and 66. The data appear to be subject to various quantitative errors of measurement and inventory, as impossible yields of coke and gas are frequently indicated.

A typical daily load curve (winter day) is shown on page 59.

2 - Operations

a - Production

Gas plant has a present capacity of approximately 56,000 m^3/day (2000 Mcf/day) of mixed coal-gas and blue water-gas, having a heating value of 4200 kg-cal/m^3 (472 Btu/cu ft). This capacity is based on use of the two water-gas sets and about three-fourths of the coal-gas benches. General information on plant and equipment is included in pages 50 to 54.

Coal-gas equipment dates back to 1870, is inherently inefficient (as compared with modern equipment) and requires a great deal of manual labor for charging coal, firing the producers, handling coke, etc. There are 38 benches, or groups of retorts, 12 with built-in producers and 26 with direct-fired furnaces. Each bench has seven horizontal stop-end retorts, and all have been refilled many times. During 1948, the number of benches available for continuous service ranged from a minimum of 15 to a maximum of 25, due to shortage of materials and skilled labor, and to the age and general condition of the equipment.

Water-gas equipment is approximately 30 years old, having been erected originally in Brest France in 1920 and transferred to Athens in 1933. There are two sets, both manually operated.

Accessory equipment is generally old but suitable for further service, and with exception of station meter and possibly the condenser, has some margin for additional plant capacity. Plant has ammonia removal but not ammonia recovery apparatus. Effectiveness of tar recovery equipment is poor with the result that distribution meters are affected. Instrumentation is generally inadequate for coal-gas production, water-gas production and for control of mixed gas. Water-gas sets are operated without air meter, steam meter or pyrometer and it is impossible to check operation. Water-gas meter is not operating and quantities of coal-gas and water-gas are estimated.

b - Distribution

Athens and its principal suburbs have a population of approximately 800,000 persons. The gas distribution system serves an area embracing 585,000 persons. The system as of March 31 1949 served 20,547 residential consumers and 2053 industrial and commercial consumers. General information on the system is included in pages 54 to 56.

Map on page 57 shows the system, line sizes and their relative capacities, the meter reading districts, and for each district the number of consumers, total sales, and sales per consumer for month of March 1948. Other data indicate pressures existing in various parts of the system on the peak of a typical day in June 1949.

Distribution pressure is changed according to plant sendout (to minimize leakage), but is limited to 100 mm (4 in.) of water because nearly all consumers' meters are of the wet type and will blow gas at a higher pressure. The result is that total pressure remains low in outlying parts of system with accompanying unsatisfactory service. The tabulation on page 60 shows sales per consumer and average peak-hour pressure in each district. Good practice requires a minimum of 75 mm (3 in.) water pressure and it may be seen from this tabulation and the map on page 57 that only one district enjoys such pressure, while in half the districts, average pressure is less than 20 mm with spot readings as low as seven to ten millimeters water pressure in several locations. Plotting the average pressure in each district against sales per consumer in that district as shown on page 61 indicates that sale of gas is, to some extent, proportional to pressure of gas being delivered, and hence that sales of gas would increase if pressure were raised in the poorly served districts. This latter inference was borne out by evidence obtained on visiting poorly served districts and discussing situation with consumers.

Unaccounted losses are high, but it is impossible to estimate the extent this is due to line losses. Station metering is poor and consumers' meters, being of the wet type, must be kept filled to proper level or consumer will benefit from resulting low registration. Adding the possibility of theft, it may be seen that there are many factors contributing to the apparent losses.

It is estimated that there are about 10,500 potential consumers located on the fringes of the existing system, some or all of which might be served if additional facilities were provided. These are located as follows:

New Ionia in north section of Athens	4,000
Chalkidon in northwest section of Athens	1,800
Psychico in east section of Athens	2,700
Old Phaleron in south section of Athens	2,000
	10,500

c - Statistics and Charts

There are included in pages 57 to 66, a map of the distribution system; a balance sheet for year ending March 31 1948; operating revenue and expense statements for year ending March 31 1949; operating data for years 1937 to 1948; gas sendout chart for years 1937 to 1948; typical daily load chart; and a table and chart illustrating relation between sales and gas pressures.

These data are of important interest and contributed in considerable degree to the formation of conclusions and recommendations.

3 - Proposed Improvements

Study and observation of property and a consideration of economic problems involved, indicate that certain improvements should be considered. These are listed below and are considered in more detail as part of Plans A-1, A-2, A-3, A-4 and A-5 in Section III.

a - Production Plant

1 - Provide proper station metering and adequate instrumentation for coal-gas and water-gas production and control.

2 - Install new carburetted water-gas set. Present coal-gas equipment and water-gas sets are old, require considerable maintenance and operating labor and are much less efficient than modern equipment. Some savings can be effected if new equipment can be installed to carry the greater part of demand, with present equipment relegated to standby, peaking or emergency status. A nine-foot automatic carburetted water-gas set, utilizing coal, coke and oil would have capacity of 56,000 m^3/day, enough to meet present requirements. Accessory equipment would include overhead bin (for the two solid fuels), skip hoist, blowers, steam accumulator, waste-heat boiler, and steam generator. New gas piping to the relief holder and from relief holder to exhausters may be required.

3 - Install electrostatic tar precipitator. Condition of consumers' meters indicates that tar is not being completely removed

by present equipment. Installation of electrostatic tar precipitator to supplement present apparatus will insure maximum tar recovery and will prevent certain meter difficulties.

4 - Install tar distillation equipment, five tons per day capacity. Tar recovered in extractors contains moisture which makes it less valuable and prevents its use for many purposes. At present, much of tar recovered is used for fuel, for lack of other suitable applications. Tar distillation apparatus will remove moisture and make available a high grade of tar suitable, among other uses, for road repair purposes.

5 - Install washer cooler. Although capacity is not known, it appears that present condenser will reach its capacity if appreciable additional gas making capacity is added to plant. If additional condensing capacity is found to be needed, installation of washer cooler to supplement present condensing capacity may be made.

b - Distribution System

1 - The low-pressure conditions existing in outlying parts of the system can be overcome by (a) additional lines from the plant to the outlying areas or (b) more economically under present circumstances, by installation of high-pressure storage stations at strategic locations. Study indicates that three high-pressure storage stations, one each in the north, east and south sections of the city, can be utilized to improve distribution pressures and supply conditions in the poorly served areas. Each storage station would consist of two high-pressure tanks having a total displacement of 235 m^3 and capable of storing 2272 m^3 at 11 atm abs. Each station would be equipped with automatic motor driven compressor and necessary control and safety instruments.

2 - It is desirable to replace gradually present wet-type consumers' meters with dry-type meters. The present meters are old and most have been repaired many times. If a program can be worked out whereby the wet meters can be replaced, beginning with those

nearest the plant (and therefore subject to greater pressure), then the system pressure can be raised and greater delivery effected. The use of the dry-type meters will insure greater accuracy of metering and will eliminate labor now required to service wet meters

3 - A concentrated effort should be made to reduce line losses. Such a program must necessarily be accompanied by steps to render metering more accurate.

4 - If additional consumers are to be served in the outlying areas, new mains, meters and services will be required.

4 - Description of Property

a - Production Plant

Plant is located near western city limits of Athens, 1.3 km southwest of Omonia Square. Three plots of land are occupied, 25,752 m^2 for gas plant proper, 4261 m^2 and 5166 m^2 for pipe and supplementary coal storage. Location plan is shown on page 67.

Plant utilizes bituminous coal to manufacture coal-gas, coke and tar. A portion of the coke produced is used to make blue water-gas which is added to coal-gas to give a mixed gas having heating value of 4200 kg-cal/m^3 (472 Btu/cu ft).

1 - Coal-Gas Manufacture

There are 38 benches, or groups or retorts, 12 with built-in producers and 26 with direct-fired furnaces. Each bench contains seven horizontal, stop-end retorts, three meters long. Average charge is 120 - 140 ig or approximately 260 - 300 lb of coal. Retorts are charged using a charging machine, but coke is removed by hand with rakes. Carbonizing period is 4.8 hours which allows five charges per day per retort. Equipment was reported to have been installed in the period 1870 - 1900. Benches have been refilled with new retorts many times.

Assuming an average charge of 120 kg of coal per retort and a yield of 0.292 m^3/kg (4.7 cu ft/lb), capacity of plant is:

46,700 m^3 of coal-gas per day with 38 benches in continuous operation.

36,900 m^3 of coal-gas per day with 30 benches in continuous operation.

32,000 m^3 of coal-gas per day with 26 benches in continuous operation.

24,600 m^3 of coal-gas per day with 20 benches in continuous operation.

During 1948 the number of benches available for continuous service ranged from a minimum of 15 to a maximum of 25, due to shortage of materials and skilled labor, and to the age and general condition of the equipment.

2 - Water-Gas Manufacture

There are two 1.66 m x 1.27 m x 1.15 m x 3.5 m high, water-gas sets, installed originally about 1920 in Brest France by the firm of Humphrey and Glasgow. They were brought to Athens and re-erected in 1933. Units are hand operated with up and down runs, but there is no air meter, steam meter or pyrometer to guide operation. Carburetors and superheaters contain checker brick but oil is not used in gas-making process. Oil meters are available. Generator blast lines are 250 mm diameter, carburetor-superheater connections 400 mm diameter, washbox outlet pipes, 250 mm diameter. Coke is used as generator fuel - about 180 kg per charge. Electric elevator is used for fuel handling. Fires are cleaned every four hours. Heating value of gas averages 1870 kg-cal/m^3 (210 Btu/cu ft) because blow run is used. Air pressure is 900 mm water and gas pressure at washbox during run is 470 mm water.

Gas production capacity of each unit is reported to be 8000 m^3/day (280 Mcf/day), or 16,000 m^3/day for the two sets. There is evidence that sets have produced as much as 20,000 m^3/day.

3 - Blowers

Two Societe Rateau (France) blowers, No. 4655 and 4656, capacity unknown, driven by 17-hp motors, No. 130 and 131, 3-phase, 220-volt, 2880-rpm.

4 - Exhausters

Two Maeron-Baer-Jernieppe (Belgium) exhausters, capacity 1870 m^3/hour each, belt driven by one Dessau horizontal steam engine. Installed 1889.

5 - Condenser

One condenser consisting of four sections of vertical 150 mm cast iron pipe, 42 pipes to a section, 7.5 m high, with 250 mm connections. Cooling is effected by sewage water flowing over outside of pipes. Spot reading June 9 1949, inlet gas temperature 49 C (121 F) and outlet gas temperature 25 C (77 F).

6 - Tar Extractors

Three Pelouze and Audoin tar extractors, capacity 20,000 m^3/day, 20,000 m^3/day and 75,000 m^3/day respectively, connections 350 mm. Installed 1870 - 1890.

7 - Naphthalene Scrubber

One rotary naphthalene scrubber, motor driven, 3 m diameter by 2 m long, connections 500 mm, differential pressure 40 mm of water, capacity 43,000 m^3/day.

8 - Ammonia Scrubbers

Two rotary ammonia scrubbers (one out of commission), 3 m diameter by 4.8 m and 3.9 m long respectively, motor driven, connections 500 mm, capacity 41,000 m^3/day each. Installed 1870 - 1890.

9 - Purifiers

Twenty-two purifiers in three groups. Water-sealed. Total oxide 121 m^3. Groups are in series and total differential

pressure is 46 mm of water. Installed 1890. Group 1 - four concrete boxes, steel tops, 4.5 m x 3 m x 1.4 m, two layers of oxide, 7 m^3 of oxide per box, connections 400 mm. Group 2 - ten cast iron boxes, steel tops, 3 m x 2.7 m x 0.7 m, one layer of oxide, 4.5 m^3 of oxide per box, connections 300 mm. Group 3 - eight cast iron boxes, steel tops, 4 m x 3 m x 0.5 m, one layer of oxide, 6 m^3 of oxide per box, connections 250 mm.

10 - Boilers

Three Babcock and Wilcox water-tube boilers, having 132 m^2 of heating surface each. Installed 1909. Built for 7.5 atmospheres pressure (110 psig) but now limited to five atmospheres pressure. Feedwater treated by Permutit system.

11 - Station Gas Meters

Three meters, one for water-gas and two for mixed gas.

No. 1 - Drum type, French manufacture, mixed gas, capacity 30,000 m^3/day, connections 350 mm. Installed 19[illegible].

No. 2 - Drum type, French manufacture, mixed gas, capacity 18,000 m^3/day, connections 300 mm. Installed 1902.

No. 3 - Drum type, French manufacture, water-gas, capacity 9800 m^3/day. Installed 1909 (out of commission).

12 - Booster

One centrifugal blower, French manufacture, maximum pressure 1100 mm of water, connections 200 mm. Belt driven from electric motor.

13 - Station Governors

Four pressure regulators, French manufacture, water sealed, connections 400 mm. Installed 1870.

14 - Oil Tank (for Naphthalene Scrubber)

One underground concrete tank, 2 m x 1.7 m x 1.4 m.

15 - Holders

Four holders, one for water-gas and three for mixed ga

No. 1 - 38 m diameter, French manufacture, steel tank, three lifts, mixed gas storage, capacity 15,000 m^3, pressure 140 mm of water, connections 500 mm. Installed 1909.

No. 2 - 22.3 m diameter, French manufacture, steel tank, two lifts, mixed gas storage, capacity 6000 m^3, pressure 160 mm of water, connections 350 mm. Installed 1900.

No. 3 - 19 m diameter, French manufacture, concrete tank, two lifts, relief holder for water-gas, capacity 3700 m^3, pressure 177 mm of water, connections 300 mm. Installed 1909.

No. 4 - 28.6 m diameter, French and Greek manufacture, concrete tank, three lifts, mixed gas storage, capacity 7000 m^3, pressure 78 mm of water, connections 500 mm. Installed 1909.

16 - Plant Shops

Blacksmith, carpenter, meter repair, foundry, machine and barber shops.

17 - Employees - Plant

Reported to be 410 as of June 1949. Most of these were on strike as of that date and plant was being operated by 200 Greek Navy men and 50 regular gas plant employees.

b - Distribution System

The distribution system was laid out when the population of Athens was much less than now and extensions have not been made to keep pace with the increase in houses and business establishments. System map is shown on page 57.

The system totals approximately 130 km of 75 mm to 600 mm diameter pipe and 215 km of pipe under 75 mm diameter. A 600 mm line carries gas from the plant northeast to center of city, a distance of about 1.3 km. Other short sections of 400 mm, 300 mm and 250 mm supply

the business district of the city. Two 200 mm lines carry gas north from the end of the 600 mm line for a distance of approximately 1.8 km and from this point, a 150 mm line extends 2.4 km to the northern limits of the city. Two lines, 150 mm and 100 mm, extend from the center of the city to the east, a distance of approximately 3.2 km. A 300 mm line extends southwest from gas plant approximately 2.6 km and, from this point, a 200 mm line extends south approximately 3.2 km to the Old Phaleron area.

There is a 150 mm welded-steel booster line from plant north to end of the 200 mm line. This booster line is operated during peak periods with a pressure of 1100 mm of water at the plant and a pressure of approximately 50 mm of water at end of line. There is a second booster line, 100 mm diameter, taking gas from end of 300 mm line on Roosevelt Street. This is operated during the peak periods at a pressure of 80 mm of water to boost gas eastwardly to a point in the neighborhood of Aiginition Hospital on Queen Sophia Street.

1 - Gas Mains

Most of the gas mains are of cast iron with bell and spigot joints and have been in the ground for many years. Ground cover ranges from 0.7 to 1.0 meters and many of the lines are under pavement. Approximately 1000 drip pots are installed to collect condensate. Considerable electrolysis has occurred in lines due to action of stray currents from direct-current tramway rails.

A few new mains have recently been installed - these are of cast iron with mechanical joints of British manufacture.

2 - Services

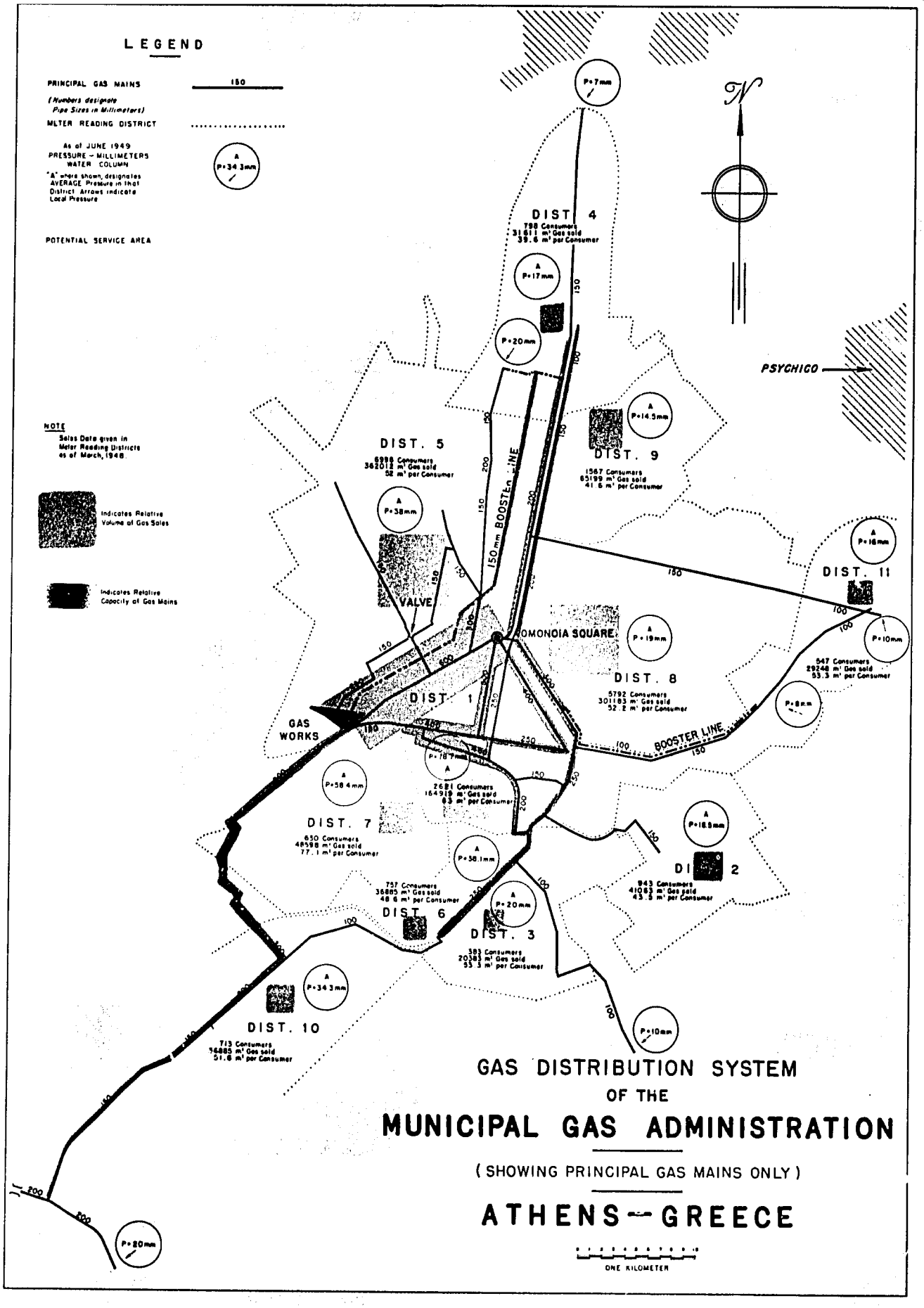
Old services are of various sizes and construction. Late installations have utilized 32 mm wrapped steel pipe - both screwed and welded - with gas cock at curb and with saddle for every service. In newer apartment houses, one service supplies several meters.

3 - Meters

There are approximately 21,500 water-sealed meters, 2500 oil-sealed meters and 300 dry meters. Meters are of various sizes and ages and of varied manufacture.

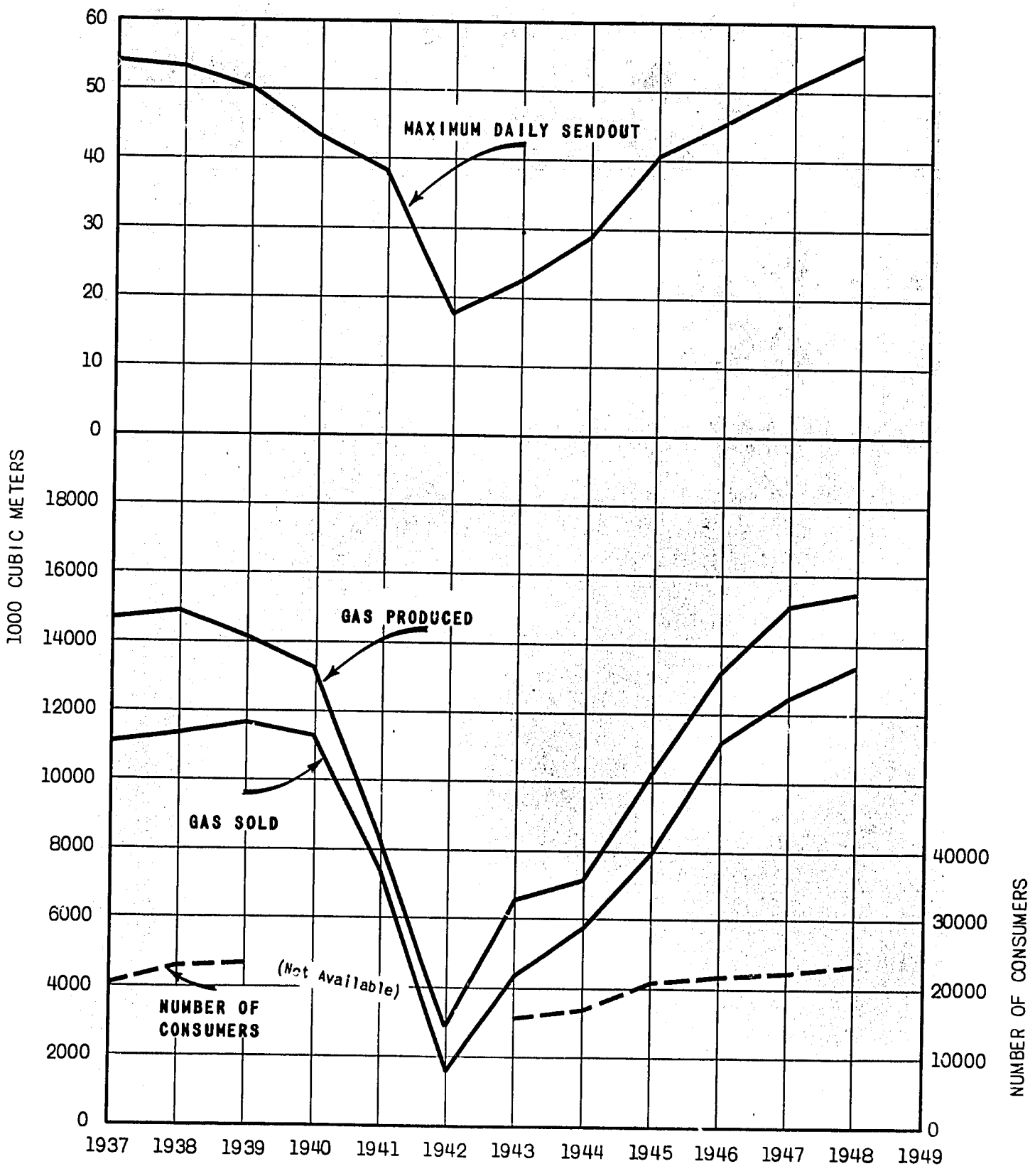
c - Maps and Photographs

A general layout drawing of the gas plant and several views of various parts of the plant are included in pages 67 to 72.


LEGEND
PRINCIPAL GAS MAINS
150
(Numbers designate Pipe Sizes in Millimeters)
METER READING DISTRICT
As of JUNE 1949
PRESSURE – MILLIMETERS WATER COLUMN
"A" where shown, designates AVERAGE Pressure in that District. Arrows indicate Local Pressure
POTENTIAL SERVICE AREA
NOTE
Sales Data given in Meter Reading Districts as of March, 1948.
Indicates Relative Volume of Gas Sales
Indicates Relative Capacity of Gas Mains
N
PSYCHICO
DIST. 4
798 Consumers
31811 m³ Gas sold
39.6 m³ per Consumer
DIST. 5
6998 Consumers
362012 m³ Gas sold
52 m³ per Consumer
DIST. 9
1567 Consumers
65199 m³ Gas sold
41.6 m³ per Consumer
DIST. 11
547 Consumers
29248 m³ Gas sold
53.3 m³ per Consumer
DIST. 8
5792 Consumers
301183 m³ Gas sold
52.2 m³ per Consumer
DIST. 1
2681 Consumers
164919 m³ Gas sold
63 m³ per Consumer
DIST. 7
650 Consumers
48598 m³ Gas sold
77.1 m³ per Consumer
DIST. 6
737 Consumers
36885 m³ Gas sold
48.6 m³ per Consumer
DIST. 3
383 Consumers
20383 m³ Gas sold
53.3 m³ per Consumer
DIST. 2
943 Consumers
41063 m³ Gas sold
43.5 m³ per Consumer
DIST. 10
713 Consumers
36885 m³ Gas sold
51.6 m³ per Consumer
150 mm BOOSTER LINE
BOOSTER LINE
VALVE
OMONOIA SQUARE
GAS WORKS
P=7mm
P=17mm
P=20mm
P=14.5mm
P=38mm
P=16mm
P=19mm
P=10mm
P=8mm
P=18.7mm
P=58.4mm
P=18.5mm
P=38.1mm
P=20mm
P=34.3mm
P=10mm
P=20mm
GAS DISTRIBUTION SYSTEM
OF THE
MUNICIPAL GAS ADMINISTRATION
(SHOWING PRINCIPAL GAS MAINS ONLY)
ATHENS — GREECE
ONE KILOMETER

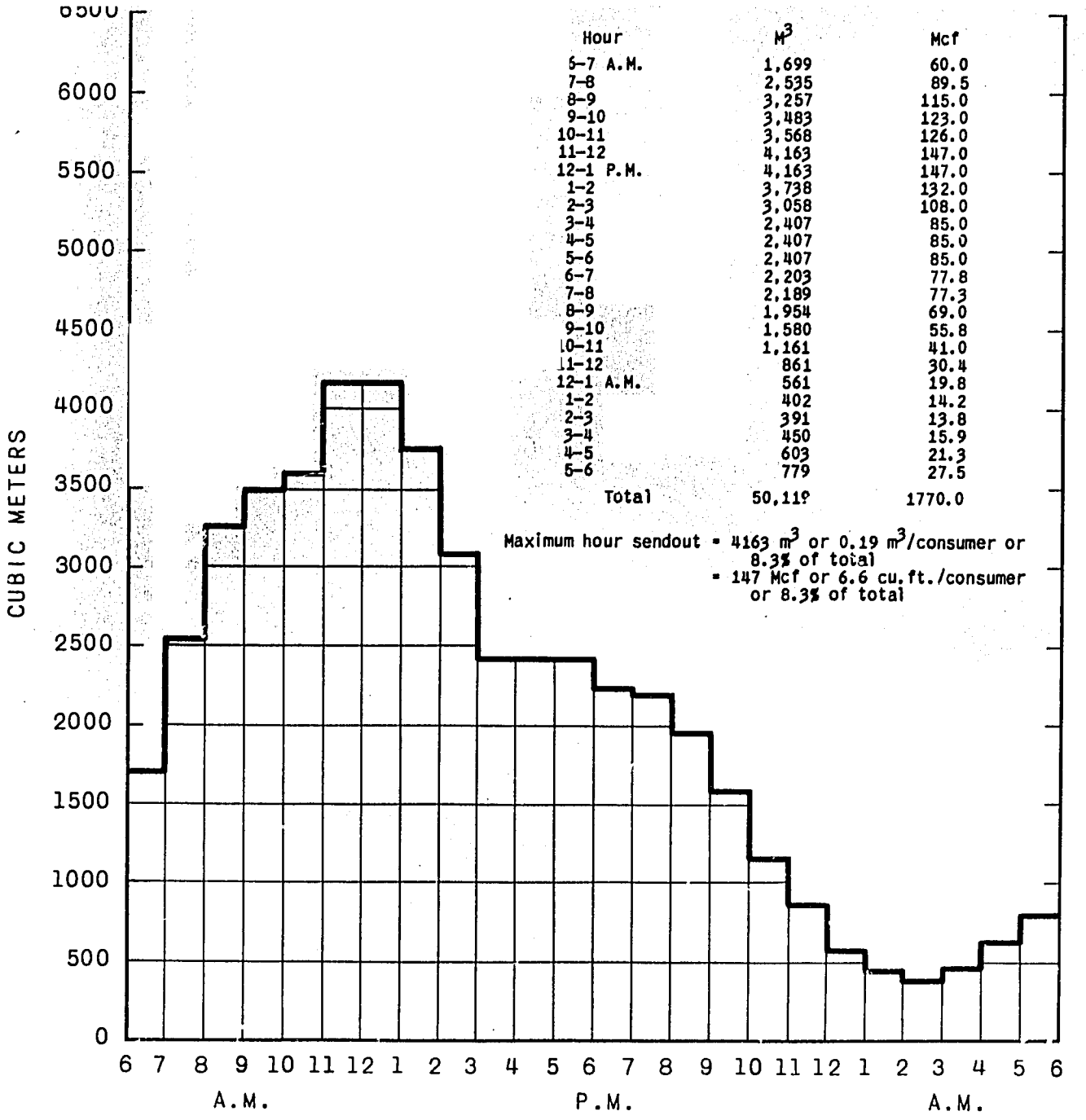
MUNICIPAL GAS ADMINISTRATION
ATHENS, GREECE

GAS PRODUCED AND SOLD, NUMBER OF CONSUMERS
AND MAXIMUM DAILY SENDOUT BY YEARS



MUNICIPAL GAS ADMINISTRATION
ATHENS, GREECE

HOURLY SENDOUT
FEBRUARY 21, 1949
TYPICAL DAY



Hour	M^3	Mcf
6-7 A.M.	1,699	60.0
7-8	2,535	89.5
8-9	3,257	115.0
9-10	3,483	123.0
10-11	3,568	126.0
11-12	4,163	147.0
12-1 P.M.	4,163	147.0
1-2	3,738	132.0
2-3	3,058	108.0
3-4	2,407	85.0
4-5	2,407	85.0
5-6	2,407	85.0
6-7	2,203	77.8
7-8	2,189	77.3
8-9	1,954	69.0
9-10	1,580	55.8
10-11	1,161	41.0
11-12	861	30.4
12-1 A.M.	561	19.8
1-2	402	14.2
2-3	391	13.8
3-4	450	15.9
4-5	603	21.3
5-6	779	27.5
Total	50,119	1770.0

Maximum hour sendout = 4163 m^3 or 0.19 m^3/consumer or 8.3% of total
= 147 Mcf or 6.6 cu.ft./consumer or 8.3% of total

MUNICIPAL GAS ADMINISTRATION
ATHENS GREECE

Approximate Relation of Sales to Pressure

Meter-Reading District	Sales per Consumer March 1948*		Average Pressure in District 11 AM to 1 PM, June 13 1949*	
	m^3	Mcf	mm water	inches water
1	63.0	2.31	78.7	3.10
2	43.5	1.54	18.5	0.73
3	53.3	1.83	20.0	0.79
4	39.6	1.39	17.0	0.67
5	52.0	1.83	38.0	1.45
6	48.6	1.71	38.1	1.50
7	77.1	2.72	58.4	2.30
8	52.2	1.83	19.0	0.75
9	41.6	1.47	14.5	0.57
10	51.8	1.82	34.3	1.35
11	53.3	1.84	16.0	0.63

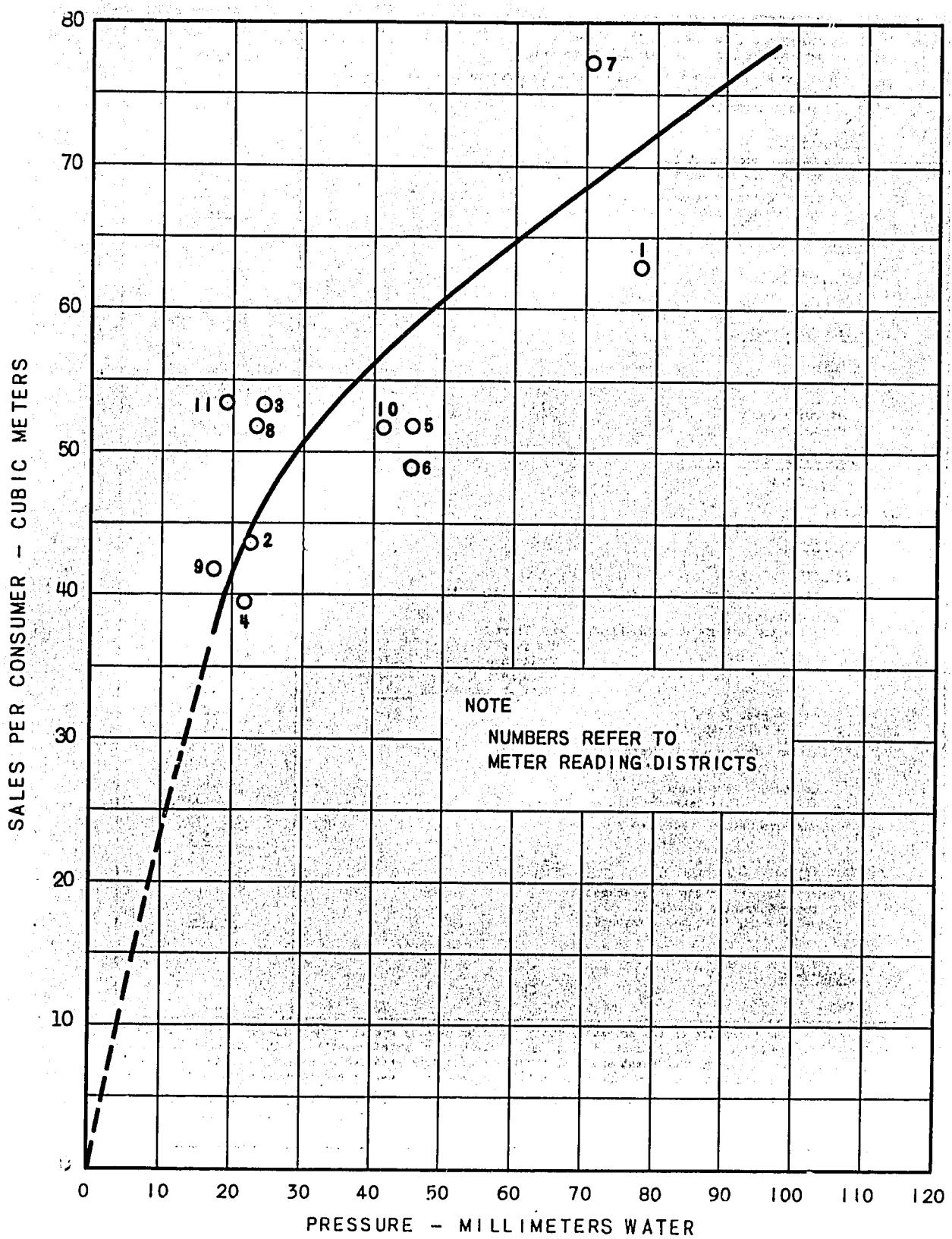
* From date available - there has been little change in conditions in interim period.

Pressure of gas in mains is considerably less than that accepted in current US practice. Sales of gas appear to be roughly proportional to available gas pressures. This is shown graphically on page 61.

MUNICIPAL GAS ADMINISTRATION
ATHENS, GREECE

RELATION OF SALE OF GAS PER CONSUMER
TO AVERAGE PRESSURE

SALES AS OF MARCH 1948
PRESSURES AS OF JULY 1949-11 A.M. TO 1 P.M.



MUNICIPAL GAS ADMINISTRATION
ATHENS GREECE
BALANCE SHEET
MARCH 31 1948

	US Dollar Equivalent (10,000 Drachmae per Dollar)	
ASSETS		
Production Plant*		
Land - book value 10/1/39 - 1 drachma	$ 0	
Improvements and Additions 10/1/39 to 3/31/48	0	$ 0
Buildings - book value 10/1/39 - 1 drachma	0	
Improvement and Additions 10/1/39 to 3/31/48	4,163	4,163
Machinery - book value 10/1/39 - 1 drachma	0	
Improvements and Additions 10/1/39 to 3/31/48	2,498	2,498
Ovens and Retorts - book value 10/1/39 - included in machinery	0	
Improvements and Additions 10/1/39 to 3/31/48	24,476	
Less depreciation	4,079	20,397
Distribution*		
Gas Mains - book value 10/1/39 - 2 drachmae	$ 0	
Improvements and Additions 10/1/39 to 3/31/48	157	157
Consumers Meters - book value 10/1/39	1,511	
Improvements and Additions 10/1/39 to 3/31/48	4,629	6,140
Tools		8,904
Cars and Trucks		10,874
Furniture		10,085
Bills Receivable		160,099
Stores		
Materials	42,644	
Coal	29,394	
Gas in Holders	1,163	
By-products	59,623	132,824
Cash and Bank Deposits		50,556
Total		$406,697
LIABILITIES		
Capital		$ 346
Reserves		
Provisions for Working Capital, Improvements and Additions		174,819
Depreciation		
Production and Distribution Plant - Past Years	239	
- This Year		
Buildings 832		
Machinery 1,061		
Distribution Mains 13	1,906	
Tools - Past Years	6,058	
- This Year	2,561	
Cars and Trucks - Past Years	2,876	
- This Year	2,111	
Furniture - Past Years	2,422	
- This Year	1,533	
Consumers Meters - Past Years	228	
- This Year	559	$ 20,493
Liabilities		
Municipality of Athens - 1 drachma	$ 0	
Consumer Guarantee Deposits	12,284	
Miscellaneous, Taxes and Insurance	198,264	$210,548
		$406,206
Adjustment		491
Total		$406,697

* The franchise of the private company which originally operated the property expired in October 1939 and ownership of the Production Plant and Distribution System reverted to the Municipality of Athens without cost. Production Plant and Distribution System were regarded as entirely written off. Since that time, depreciation has been made only on fixed assets which were thereafter acquired as improvements and additions.

Data on these sheets were obtained from best available sources. Figures were originally in drachmae and, for convenience, have been converted to US dollars on basis of 10,000 drachmae per US dollar.

MUNICIPAL GAS ADMINISTRATION
ATHENS GREECE
OPERATING REVENUE AND EXPENSE*
12 MONTHS ENDING MARCH 1949
SUMMARY

		US Dollar Equivalent (10,000 Drachmae per Dollar)
Operating Revenue		
Gas - Residential		$ 976,481
Industrial		244,824
Total		$1,221,305
Meter Rental		115,292
Sub-total		$1,336,597
Servicing		20,116
Truck Delivery		51,919
Miscellaneous		5,636
Total Operating Revenue		$1,414,268
Operating Expense		
Production - Coal Gas		$ 74,007
Water Gas		241,947
Storage		8,590
Total		$ 324,544
Distribution		279,325
General and Administrative		495,325
Sub-total		$1,099,194
Taxes (appropriation)		15,000
Total Operating Expenses		$1,114,194
Net From Operation		$ 300,074
Depreciation	$ 16,000	
Renewals and Replacements	152,075	
Total	$168,075	$ 168,075
Balance		$ 131,999

DETAILS OF OPERATION
(Dollar Figures Represent US Dollar Equivalent @ 10,000 Drachmae per Dollar)

		Metric Units	English Units
Revenue and Sales			
Revenue per Residential Consumer	$ 47.52		
Revenue per Industrial Consumer	119.25		
	$ 54.04		
Sales per Residential Consumer		547.8 m^3	19.34 Mcf
Sales per Industrial Consumer		995.6 m^3	35.17 Mcf
Average		588.4 m^3	20.78 Mcf
Average Residential Rate		$0.087/$m^3$	$2.46/Mcf
Average Industrial Rate		0.119/m^3	3.39/Mcf
		$0.092/$m^3$	$2.60/Mcf
Production			
Coal Gas			
Coal Gas Produced		290 m^3/ton	4.61 cu ft/lb
Bench Fuel		18.1%	
Coke Produced		78.1%	
Tar Produced - per ton carbonized		35.1 kg/ton	7.43 gal/2000 lb
Heating Value		5134 kg-cal/m^3	577 Btu/cu ft
Production Cost - based on gas produced		$0.008/$m^3$	$0.220/Mcf
Water Gas			
Water Gas Produced		1939 m^3/ton coke	62 Mcf/2000 lb
Heating Value		1870-2580 kg-cal/m^3	210-290 Btu/cu ft
Production Cost - based on gas produced		$0.040/$m^3$	$1.118/Mcf
Mixed Gas			
Production Cost - based on gas produced		$0.021/$m^3$	$0.587/Mcf
based on gas sold		$0.024/$m^3$	$0.691/Mcf
Distribution Expense			
Expense per Consumer			$12.36
General and Administrative Expense			
Expense per Consumer			$21.92
Average Number of Consumers			
Residential	20,547		
Industrial	2,053		
Total	22,600		
Unaccounted-for Gas	15%	2,353,000 m^3	83,100 Mcf
Unaccounted-for Gas per mile of 3-in. equivalent main			399 Mcf

Note Discrepancies in relationship between amount of coal carbonized or generator fuel burned and yields of coke and gas, can probably be explained by one or more of following factors: errors in inventory, errors in plant metering, or delivery of gas having substandard heating value.

MUNICIPAL GAS ADMINISTRATION
ATHENS GREECE
OPERATING REVENUE AND EXPENSE
12 MONTHS ENDING MARCH 31 1949
DETAILS
(Dollar Figures Represent US Dollar Equivalent
@ 10,000 Drachmae Per Dollar)

				Per m^3 Sold	Per Mcf Sold
Operating Revenue					
Gas - Residential - 11,256,000 m^3	$ 976,481			$0.087	$2.457
Industrial - 2,044,000 m^3	244,824			0.119	3.390
Total 13,300,000 m^3	$1,221,305		$1,221,305	$0.092	$2.600
Meter Rental			115,292	$0.008	$0.245
Sub-total			$1,336,597	$0.100	$2.845
Servicing			20,116		
Truck Delivery			51,919		
Miscellaneous			5,636		
Total Operating Revenue			$1,414,268	$0.106	$3.012
Operating Expense				Per m^3 Produced	Per Mcf Produced
I - Production					
Coal Gas - 9,527,000 m^3 produced					
Labor - Salaries 24.4%		$ 75,000			
Foremen 61.0%		13,100			
Ovens & Retorts 100.0%		81,558			
Boilers 50.0%		6,439			
Purification 61.0%		2,590			
Coal 100.0%		27,870			
Total Labor		$206,557	$ 206,557	$0.022	$0.614
Material					
Coal Carb 32,900 ton @ $15.80		$519,692			
Boiler Fuel					
Coal 482 ton @ $15.80		7,609			
Coke 131 ton @ 37.00		4,830			
Tar 0.5 ton @ 50.00		26			
Bench Fuel					
Coke 4,750 ton @ $40.70		193,439			
Breeze 463 ton @ 30.00		13,877			
Tar 773 ton @ 50.00		38,638			
Power 61%		1,390			
Purif Mat 61%		3,325			
Coal Insurance 100%		748			
Water 61%		2,100			
Miscellaneous 61%		253			
Reserve - Ovens & Retorts		14,853			
Total Material		$800,780	$ 800,780	$0.084	$2.380
Maintenance					
	Mat	Labor	Total		
Ovens 100%	$ 5,245	$14,804	$ 20,049		
Piping 61%	250	748	998		
Building 61%	725	1,705	2,430		
Condensers 61%	863	1,320	2,183		
Boilers 50%	1,314	853	2,167		
Equipment 61%	1,498	4,140	5,638		
Yard 61%	36	2,130	2,166		
Meters 61%	18	173	191		
Tools 45.7%	1,780	5,450	7,230		
Total	$11,729	$31,323	$ 43,052	$ 43,052	$0.005	$0.128
Total Labor, Material and Maintenance				$1,050,389	$0.111	$3.122
Residual Credit					
Coke 21,860 ton @ $40.72			($ 890,049)		
3,857 ton @ 16.02			(61,711)		
25,717 ton @ $37.00			($ 951,760)		
Tar 1,155 ton @ $50.00			($ 57,730)		
Cinders 2,116 ton @ 3.50			(7,399)		
Carbon 27 ton @ 75.50			(2,040)		
			($1,018,929)		
Residual Operating Expense					
Coke - Labor			$ 36,574		
Loading			4,103		
			$ 40,677		
Transport			1,798		
			$ 42,475		
Residual Maintenance Expense					
Coke Crusher - Labor			$ 72		
			$ 42,547		
Residual Credit - Net				($ 976,382)	($0.103)	($2.902)
Net Production Expense - Coal Gas				$ 74,007	$0.008	$0.220

Note Data on these sheets were obtained from available sources and were not originally in breakdown form presented here. Some rearrangement and allocation has been arbitrarily made, based on study of operation of property. Expense and revenue figures were originally in drachmae but for convenience have been converted to US dollars on basis of 10,000 drachmae per US dollar.

( ) indicates credit

ATHENS - OPERATING REVENUE AND EXPENSE
CONTINUED

					Per m^3 Produced	Per Mcf Produced
Water Gas - 6,126,000 m^3 produced						
Labor - Salaries 15.6%			$ 48,000			
Foremen 39%			8,462			
Generating 100%			12,981			
Boilers 50%			6,439			
Purification 39%			1,695			
			$ 77,577	$ 77,577	$0.013	$0.359
Material						
Gen Fuel	3,159 ton @ $40.72		$128,627			
Boiler Fuel						
Coal	483 ton @ $15.80		7,624			
Coke	131 ton @ $37.0[illegible]		4,830			
Power	39%		895			
Purif Mat	39%		2,122			
Water	39%		1,347			
Miscellaneous	39%		162			
			$145,607	$ 145,607	$0.024	$0.673
Maintenance	Mat	Labor	Total			
Generators 100%	$1,675	$ 1,469	$ 3,144			
Piping 39%	160	479	639			
Buildings 39%	463	1,089	1,552			
Condensers 39%	549	835	1,384			
Boilers 50%	1,314	852	2,166			
Equipment 39%	957	2,659	3,616			
Yard 39%	23	1,528	1,551			
Meters 39%	11	110	121			
Tools 29.3%	1,140	3,450	4,590			
	$6,292	$12,471	$ 18,763	$ 18,763	$0.003	$0.086
Total Production Expense - Water Gas				$ 241,947	$0.040	$1.118
Storage						
Holder Maintenance						
Material			$ 7,[illegible]74			
Labor			876			
			$ 8,590	$ 8,590		
Total Production Expense						
Coal Gas 9,527,000 m^3				$ 74,007		
Water Gas 6,126,000 m^3				241,947		
Storage -				8,590		
15,653,000 m^3				$ 324,544	$0.021	$0.587
					Per m^3 Sold	Per Mcf Sold
Total Production Expense					$0.[illegible]4	$0.691
II - Distribution						
Operation						
Labor - Salaries 20%			$ 61,500			
Services			8,657			
			$ 70,157	$ 70,157		
Material - Services			$ 5,891			
Meters			2,766			
			$ 8,657	$ 8,657		
				$ 78,814		
Maintenance	Mat	Labor	Total			
Distribution 100%	$73,819	$ 97,865	$171,684			
Tools 25%	980	2,979				
Meters 100%	-	24,868	[illegible],868			
	$74,799	$125,712	$200,511	$ 200,511		
Total Distribution Expense				$ 279,325	$0.021	$0.595
III - General and Administrative Expense						
Salaries - 40%			$123,550			
Insurance			188,840			
General			117,812			
Transport						
Material	$ 8,094					
Labor	15,363					
	$23,457		$ 23,457			
Non-productive Wages			34,904			
			$488,563	$ 488,563		
Maintenance	Mat	Labor	Total			
Furniture	$ 615	$ 1,177	$ 1,792			
Cars	1,376	487	1,863			
Lorries	1,700	1,407	3,107			
	$ 3,691	$ 3,071	$ 6,762	$ 6,762		
Total General and Administrative Expense				$ 495,325	$0.037	$1.055
IV - Taxes				$ 15,000	$0.001	$0.032
Total Operating Expense				$1,114,194	$0.083	$2.373
Net from Operation				$ 300,074	$0.023	$0.639

MUNICIPAL GAS ADMINISTRATION
ATHENS GREECE

ANNUAL OPERATING DATA - METRIC UNITS

Year	Annual Production of Gas 1000 m³	Annual Sales of Gas 1000 m³	Gas Lost or Unaccounted 1000 m³	Gas Lost or Unaccounted Per Cent of Production	Maximum Daily Sendout 1000 m³	Load Factor Per Cent	Number of Consumers
1937	14,772	11,173	3,599	24.3	54.1	75	21,000
1938	14,954	11,377	3,577	23.9	53.6	77	23,000
1939	14,178	11,601	2,577	18.2	50.3	77	23,194
1940	13,284	11,348	1,936	14.6	43.8	83	-
1941	8,204	7,380	824	10.1	38.4	59	-
1942	2,853	1,592	1,261	44.2	17.5	45	-
1943	6,554	4,321	2,233	34.2	22.2	81	15,690
1944	7,196	5,767	1,429	19.9	28.9	68	16,838
1945	10,222	7,967	2,255	22.1	40.4	69	20,887
1946	13,198	11,087	2,111	16.0	45.4	80	21,900
1947	15,058	12,481	2,577	17.1	50.7	81	22,302
1948	15,463	13,301	2,162	14.0	55.5	76	23,570
	135,936	109,395	26,541	19.5			

ANNUAL OPERATING DATA - ENGLISH UNITS

Year	Annual Production of Gas Mcf	Annual Sales of Gas Mcf	Gas Lost or Unaccounted Mcf	Gas Lost or Unaccounted Per Cent of Production	Maximum Daily Sendout Mcf	Load Factor Per Cent	Number of Consumers
1937	521,600	394,520	127,080	24.4	1,910	75	21,000
1938	528,030	401,720	126,310	23.9	1,890	77	23,000
1939	500,630	409,630	91,000	18.2	1,780	77	23,194
1940	469,060	400,700	68,360	14.6	1,550	83	-
1941	289,680	260,590	29,090	10.1	1,360	59	-
1942	100,740	56,210	44,530	44.2	620	45	-
1943	231,420	152,570	78,850	34.2	780	81	15,690
1944	254,090	203,630	50,460	19.9	1,020	68	16,838
1945	360,940	281,300	79,640	22.1	1,430	69	20,887
1946	466,020	391,480	74,540	16.0	1,610	80	21,900
1947	531,700	440,700	91,000	17.1	1,790	81	22,302
1948	546,000	469,660	76,340	14.0	1,960	76	23,570
	4,799,910	3,862,710	937,200	19.5			

OPERATING DATA - METRIC UNITS
12 MONTHS ENDING MARCH 31 1949

	Coal Carbonized Metric Tons	Coke Produced Metric Tons	Tar Produced Metric Tons	Gas Produced - 1000 m³ Coal Gas	Gas Produced - 1000 m³ Water Gas	Gas Produced - 1000 m³ Total	Gas Sold - 1000 m³ Residential	Gas Sold - 1000 m³ Commercial and Industrial	Gas Sold - 1000 m³ Total	Gas Lost or Unaccounted 1000 m³	Gas Lost or Unaccounted Per Cent of Production
April 1948	2,744	2,019	83	762	579	1,341	1,027	173	1,200	141	10.5
May 1948	2,635	1,950	79	738	566	1,304	985	164	1,149	157	12.0
June 1948	2,301	1,703	79	646	599	1,245	970	160	1,130	115	9.2
July 1948	2,298	1,700	69	638	532	1,170	888	159	1,047	123	10.5
August 1948	2,230	1,650	67	631	470	1,101	761	149	910	191	17.3
September 1948	2,252	1,666	68	657	475	1,132	743	151	894	238	21.0
October 1948	2,663	1,971	80	789	501	1,290	831	169	1,000	290	22.5
November 1948	2,665	1,972	80	811	524	1,335	962	177	1,139	196	14.7
December 1948	3,328	2,462	100	985	489	1,474	973	181	1,154	320	21.7
January 1949	-	-	-	1,014	402	1,416	1,053	188	1,241	175	12.4
February 1949	-	-	-	889	468	1,357	1,023	182	1,205	152	11.2
March 1949	-	-	-	967	519	1,486	1,040	191	1,231	255	17.1
	-	-	-	9,527	6,126	15,653	11,256	2,044	13,300	2,353	15.0

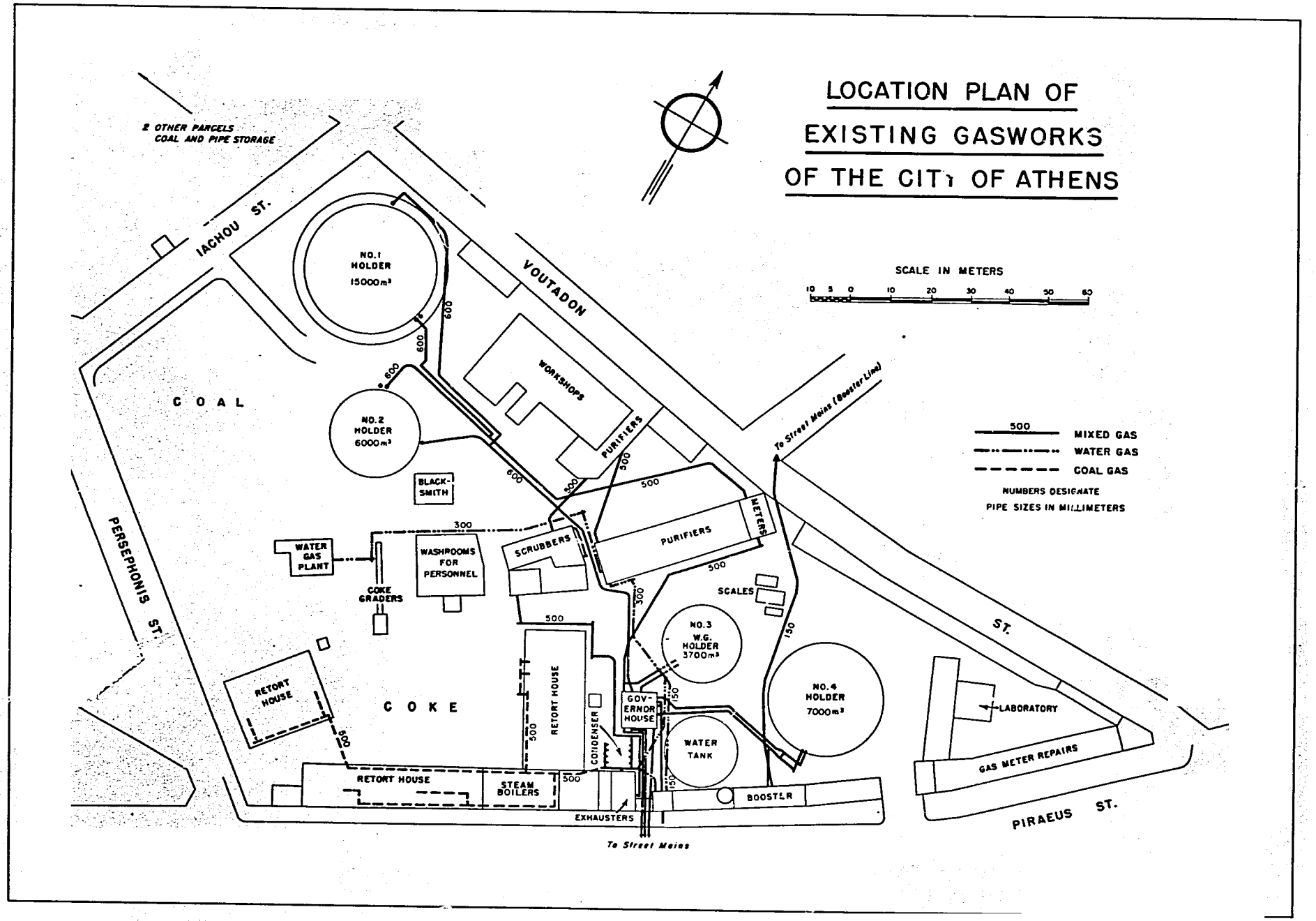
Coal gas - 60.9%
Water gas - 39.1%
Coke produced per ton of coal carbonized - 740 kilograms) 9 months
Tar produced per ton of coal carbonized - 30.5 kilograms)

OPERATING DATA - ENGLISH UNITS
12 MONTHS ENDING MARCH 31 1949

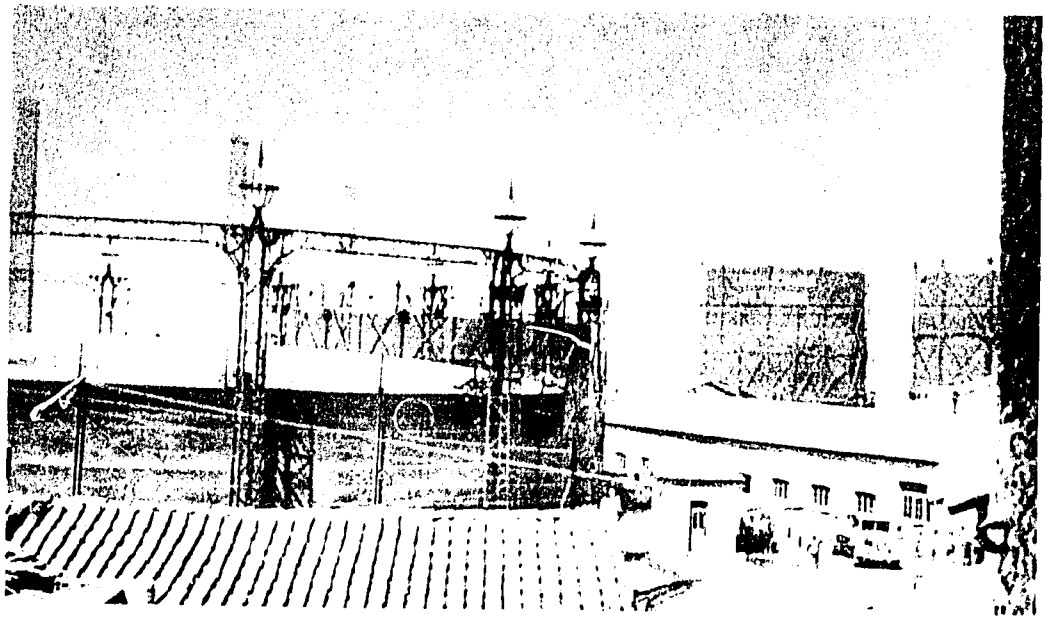
	Coal Carbonized Short Tons	Coke Produced Short Tons	Tar Produced Gallons	Gas Produced - Mcf Coal Gas	Gas Produced - Mcf Water Gas	Gas Produced - Mcf Total	Gas Sold - Mcf Residential	Gas Sold - Mcf Commercial and Industrial	Gas Sold - Mcf Total	Gas Lost or Unaccounted Mcf	Gas Lost or Unaccounted Per Cent of Production
April 1948	3,024	2,225	17,585	26,910	20,440	47,350	36,260	6,110	42,370	4,980	10.5
May 1948	2,904	2,149	16,738	26,060	20,060	46,120	34,770	5,790	40,560	5,560	12.0
June 1948	2,536	1,877	16,734	22,810	21,150	43,960	34,250	5,650	39,900	4,060	9.2
July 1948	2,532	1,873	14,596	22,530	18,780	41,310	31,350	5,620	36,970	4,340	10.5
August 1948	2,457	1,818	14,182	22,280	16,600	38,880	26,860	5,260	32,120	6,760	17.3
September 1948	2,482	1,836	14,305	23,200	16,770	39,970	26,240	5,330	31,570	8,400	21.0
October 1948	2,935	2,172	16,916	27,860	17,690	45,550	29,240	5,980	35,320	10,230	22.5
November 1948	2,937	2,173	16,927	28,640	18,500	47,140	33,960	6,250	40,210	6,930	14.7
December 1948	3,667	2,713	21,138	34,780	17,270	52,050	34,360	6,390	40,750	11,300	21.7
January 1949	-	-	-	35,800	14,180	49,980	37,170	6,640	43,810	6,170	12.4
February 1949	-	-	-	31,390	16,530	47,920	36,120	6,440	42,560	5,360	11.2
March 1949	-	-	-	34,140	18,330	52,470	36,720	6,740	43,460	9,010	17.1
	-	-	-	336,400	216,300	552,700	397,400	72,200	469,600	83,100	15.0

Coal gas - 60.9%
Water gas - 39.1%
Coke produced per ton of coal carbonized - 1,480 lb) 9 months
Tar produced per ton of coal carbonized - 5.85 gal)

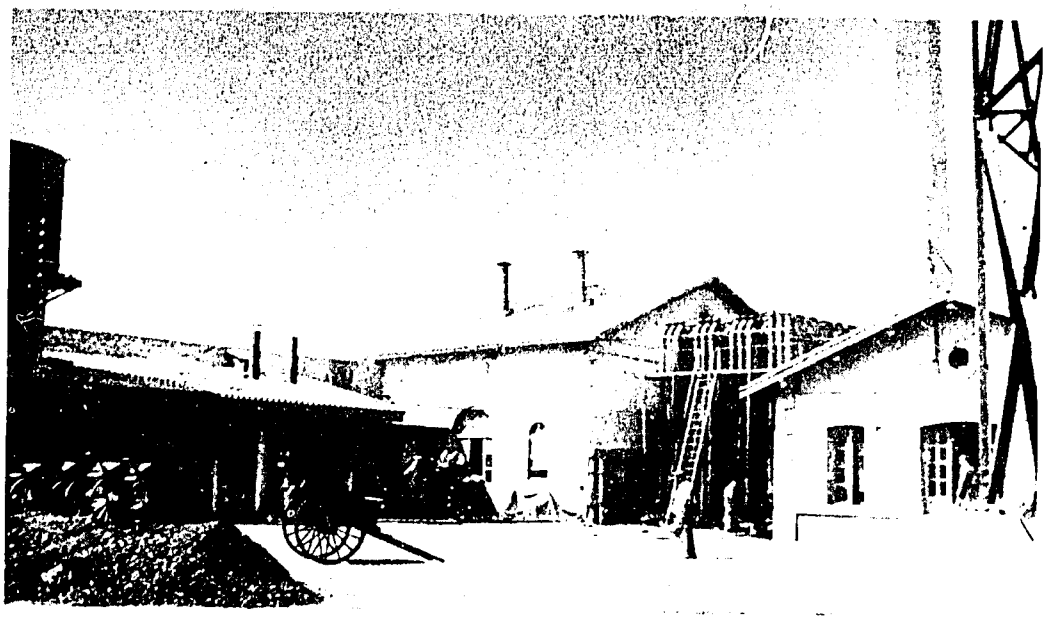
Discrepancies in relationship between amount of coal carbonized and the yields of coke and gas, can probably be explained by one or more of the following factors: errors in inventory, errors in plant metering, or delivery of gas having substandard heating value.


LOCATION PLAN OF
EXISTING GASWORKS
OF THE CITY OF ATHENS
SCALE IN METERS
10 5 0 10 20 30 40 50 60
500 MIXED GAS
WATER GAS
COAL GAS
NUMBERS DESIGNATE
PIPE SIZES IN MILLIMETERS
2 OTHER PARCELS
COAL AND PIPE STORAGE
IACHOU ST.
VOUTADON
PERSEPHONIS ST.
PIRAEUS ST.
NO.1 HOLDER 15000m³
NO.2 HOLDER 6000m³
NO.3 W.G. HOLDER 3700m³
NO.4 HOLDER 7000m³
COAL
COKE
WORKSHOPS
BLACK-SMITH
WATER GAS PLANT
COKE GRADERS
WASHROOMS FOR PERSONNEL
SCRUBBERS
PURIFIERS
METERS
SCALES
RETORT HOUSE
CONDENSER
GOV-ERNOR HOUSE
WATER TANK
STEAM BOILERS
EXHAUSTERS
BOOSTER
LABORATORY
GAS METER REPAIRS
To Street Mains (Booster Line)
To Street Mains

MUNICIPAL GAS ADMINISTRATION
ATHENS GREECE

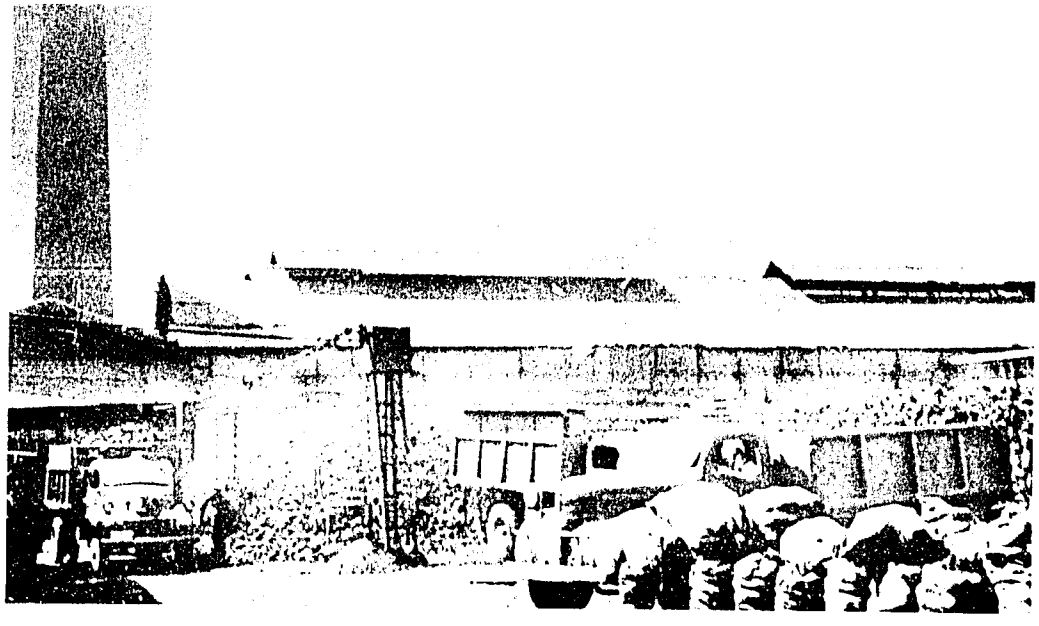


General View of Plant, Looking North
Showing Holders and Scales

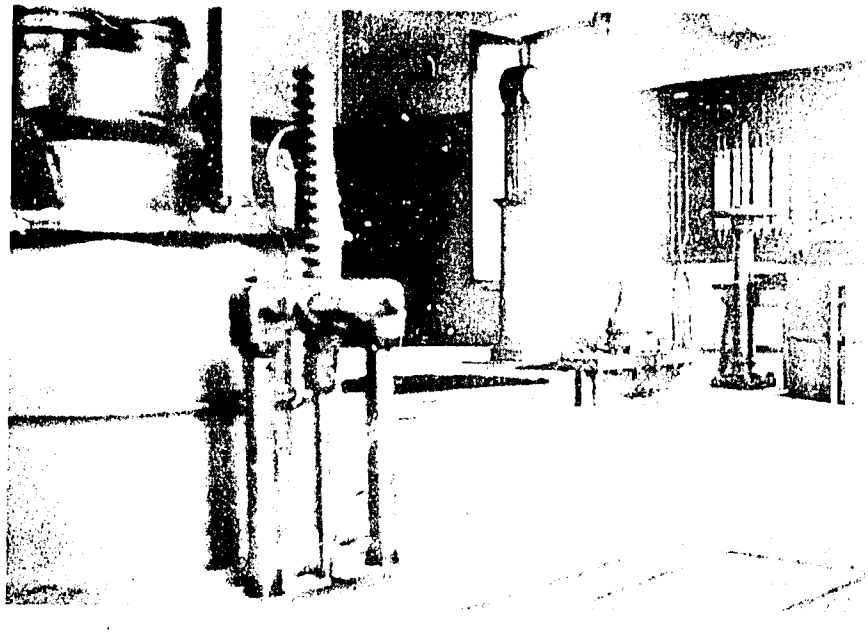


Retort House - Condenser - Governor Building

MUNICIPAL GAS ADMINISTRATION
ATHENS GREECE

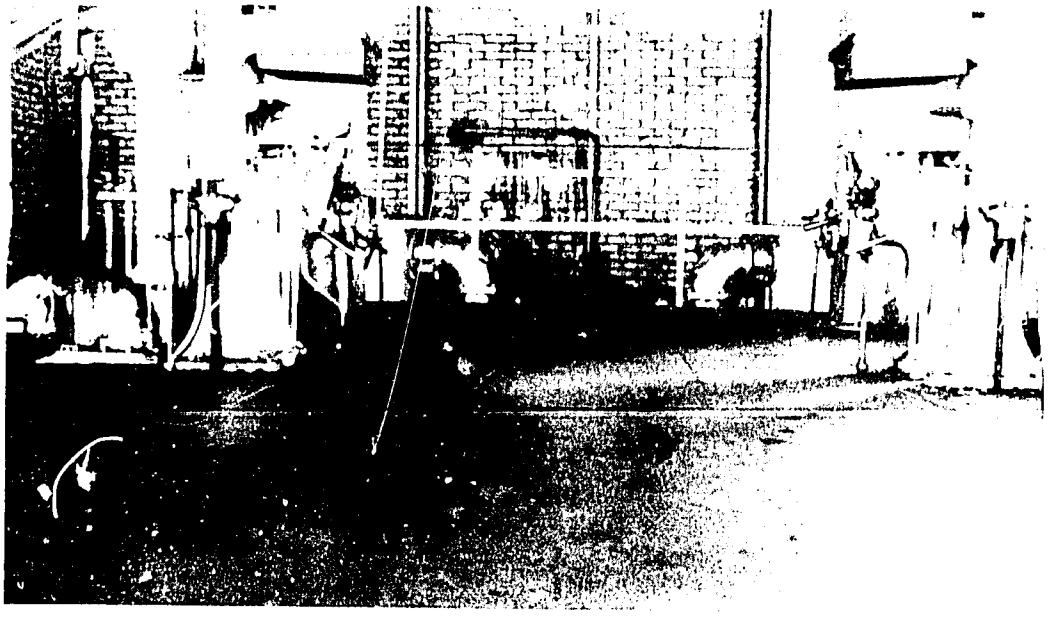


Retort House - Coke Handling

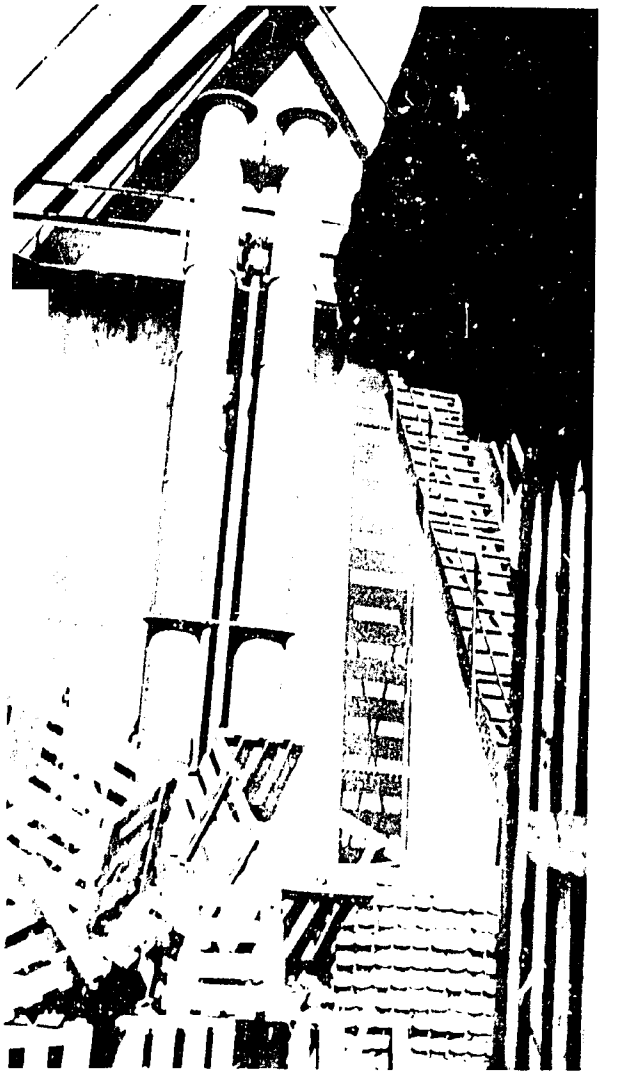


Interior - Governor House

MUNICIPAL GAS ADMINISTRATION
ATHENS GREECE



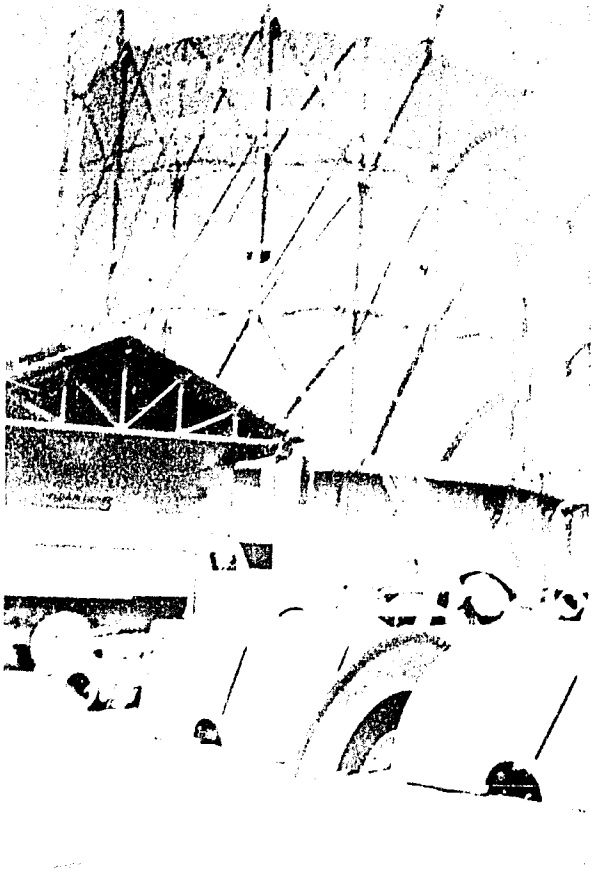
Operating Floor
Water Gas Sets



No. 2 Holder
Inlet Connection

MUNICIPAL GAS ADMINISTRATION
ATHENS GREECE

No. 2 Holder and Parts of Naphthalene Scrubber Under Repair



Operating Floor
Water Gas Sets

MUNICIPAL GAS ADMINISTRATION
ATHENS GREECE

Meter Shop
Spare Retorts
Office Building

B - THE HELLENIC TOWN GAS COMPANY INC - PIRAEUS

1 - General

The gas production plant and distribution system in the city of Piraeus are owned and operated by The Hellenic Town Gas Company, Inc, a private Greek company. Present franchise expires in 1963. Property is valued at approximately $800,000 as indicated in balance sheet shown on page 87.

The Company, though privately owned, is subsidized by the Greek government to the extent that it obtains coal at prices below cif cost - at expense of other users who make up difference by paying a higher price for their own requirements. It receives further support from sale of coke at prices generally in line with high prices of other fuels. Any further support needed to bring revenue in line with expenses is obtained by adding a special charge per cubic meter of gas sold. This special charge includes an allowance for amortization reserves.

Unlike the municipal operation at Athens, the Company is subject to property and income taxes, though the total taxation is low, presumably in keeping with the governmental policy of subsidizing the gas industry.

The Company is subject to duty on equipment which it imports for its operations. At the present time, there is in Piraeus customs a supply of special brick and other equipment purchased in Germany in 1947 for the repair of the Otto oven. Reported cost was $30,000 (equivalent) and it is held for customs charges of $8000 and warehousing charges of $4000.

Sales tax of seven per cent on residential gas, ten per cent on industrial gas and ten per cent on coke and tar are collected for the government. A welfare tax of one per cent is also collected on industrial gas sales.

The Company appears to be well managed if allowances are made for economic conditions in Greece. Although Company is quite small, all

operating costs compare favorably with the much larger municipal operation at Athens, though in general, production, distribution and administration costs are higher than for a similar operation in the United States. Net production costs are somewhat in line with United States practice, but only because of the coal subsidy and the high selling price of coke. Factors tending to lower the operating costs (and hence the selling price of gas) are (1) use of amortization charges for operating expenses - apparently economic conditions require deferred amortization as collected monies are not held as reserve, (2) governmental subsidy of coal and (3) high selling price of coke and tar. Factors tending to raise operating costs (and hence the selling price of gas) are (1) high price paid for coal which, even with the subsidy, is about 50 per cent higher than a United States gas company would have to pay, (2) high labor, distribution and administration expense (which includes military security), (3) condition of gas production equipment which has deteriorated for lack of adequate maintenance, (4) relatively low sales per consumer and (5) high unaccounted losses. The net result of all these factors is that gas must be sold at very high rates - two to three times as high as for a similar sized operation in the United States.

Flat rates are charged regardless of minimum use or load factor. Industrial and commercial consumers are charged higher rates than residential consumers on the theory that industry can better afford to pay - just the opposite of practice in the United States, where industrial and commercial consumers obtain the lower rates that are justified by greater use and higher load factors.

The following schedule of rates was in effect in June 1949:

Residential Gas (Including Public Service) - for Cooking, Water Heating, Small Amount of Space Heating			
	Drachmae/m^3	$/$m^3$	$/Mcf
Base Price	760.00	0.760	2.152
Sales Tax - 7%	53.20	0.053	.151
Special Charge for Fuel Adjustment and Amortization - 20%	152.00	0.152	.430
Meter Rental	80.00	0.080	.227
	1045.20	$1.045	$2.960

Commercial Gas (and Industrial) - for Coffee Shops, Pastry Shops, Bakeries, Printing Industry, Manufacture of Boxes, Glassware, Ceramics, Electric Lamp Bulbs, Etc			
	Drachmae/m^3	$/$m^3$	$/Mcf
Base Price	1045.00	1.045	2.959
Sales Tax - 10%	104.50	0.105	.296
Welfare Tax - 1%	10.45	0.010	.030
Special Charge for Fuel Adjustment and Amortization - 20%	209.00	0.209	.592
Meter Rental	80.00	0.080	.227
	1448.95	$1.449	$4.104

Operating revenue and expense data for 12 months ending December 31 1948 are shown on pages 88, 89 and 90. Sales tax collections are not included. It may be noted that special charges amounting to $37,411 and which include money supposedly for amortization, have been used for operating expenses. The amount of $5183, shown as Net from Operation, is less than two per cent of gross revenue.

Details of operation for 12 months ending December 31 1948 are shown on page 88, and additional annual operating data are given on pages 85 and 91. The data appear to be subject to various quantitative errors of measurement and inventory, as impossible yields of coke and gas are frequently indicated.

A typical daily load curve (winter day) is shown on page 86.

2 - Operations

a - Production

Gas plant has a present capacity of approximately 12,500 m^3/day (440 Mcf) of coal-gas having a heating value of 4200 kg-cal/m^3 (472 Btu/cu ft). This capacity is based on use of the Otto oven and four of the six horizontal retorts. General information on plant and equipment is included in pages 79 to 82.

The Otto oven was designed to produce 10,300 m^3 of coal-gas per day. Because of poor maintenance, faulty operation and low quality coal - all incident to the war - side walls of the retorts have become

warped so that it is impossible to charge the normal quantity of coal, a longer period of time is required for carbonizing and much time is lost in freeing the coke which has a tendency to hang up. These factors increase labor costs and decrease efficiency and capacity of unit. In its present condition, the maximum daily output from the Otto oven is approximately 7200 m^3/day - 35 per cent lower than its rated capacity. The unit was installed in 1938 and, with exception of various instruments and gages which disappeared during the war, accessory equipment is in good condition. New brick and other repair items for the oven were purchased in Germany in 1947 but are now held in Piraeus customs for payment of duty and warehousing charges. Circumstances attending the impounding of the materials are obscure. The occurrence is unfortunate - especially in view of other subsidy and assistance received from the Greek government - since loss of capacity of efficient Otto oven and accompanying heavier operation of less efficient horizontal retorts, has resulted in higher coal consumption and considerable extra labor costs.

The horizontal retorts date back to 1900. There are six benches of seven horizontal stop-end retorts each. This equipment is inherently inefficient (as compared to modern equipment), incurs heavy maintenance costs and requires a great deal of manual labor for charging coal, firing the producers and handling coke.

Accessory equipment is generally new and in good condition. Exhausters, condensers, tar extractors, naphthalene scrubber, ammonia scrubber, station governors and one station meter were installed in 1938 and their capacity matches that of the Otto oven. Purifiers and one station meter were installed in 1904. An additional condenser, naphthalene scrubber, ammonia scrubber and purifiers will be required if plant output is increased appreciably over present maximum capacity.

Some of the plant buildings were damaged by bombs during the war and have not been repaired.

b - Distribution

The population of Piraeus is estimated to be approximately 228,000 persons. The distribution system as of December 31 1948 served

3221 residential consumers and 807 industrial and commercial consumers. General information on the system is included on page 83.

Map on page 84 shows the system, line sizes and their relative capacities, the meter-reading districts, and line pressures existing in various parts of the system on the peak of a typical day in July 1949.

Distribution pressure is changed according to plant sendout (to minimize leakage), but is limited to 100 mm (4 in.) of water because consumers' meters are of the wet type and will blow gas at a higher pressure.

The system is compact and pressure distribution is fairly good, though there is some evidence that better service might be rendered if slightly higher pressure could be carried at peak periods. Good practice in the United States requires a minimum of 75 mm (3 in.) of water. The tabulation below indicates that sale of gas is, to some extent, proportional to pressure of gas being delivered and hence that sales of gas would increase if the pressure could be raised in the outlying parts of the system.

Approximate Relation of Sales to Pressure				
Meter-Reading District	March 1949 Sales per Consumer		Average Pressure in District 11 AM to 1 PM, July 2 1949	
	m^3	Mcf	mm water	in. water
1	56.3	1.98	50	1.97
2	47.6	1.68	41	1.60
3	54.0	1.91	45	1.77
4	68.8	2.44	57	2.25

Unaccounted losses are high, but it is impossible to say to what extent this is due to line losses, as there are over 300 consumers being served without meters. In addition, consumers' meters, being of the wet type, must be kept filled to the proper level or consumer will benefit from resulting low registration.

The distribution system was damaged in 32 locations by bombing during the war. The breaks, for the most part, have been repaired with undersize pipe, with result that restrictions exist.

It is understood that there are about 8000 potential customers in the area who would subscribe to the use of gas if it could be made available to them.

c - Statistics and Charts

There are included in pages 84 to 91, a map of the distribution system; a balance sheet for year ending December 31 1948; operating revenue and expense statements for year ending December 31 1948; operating data for years 1937 to 1948; gas sendout chart for years 1937 to 1948; and typical daily load chart.

These data are of important interest and contributed in considerable degree to the formation of conclusions and recommendations.

3 - Proposed Improvements

Study and observation of property and a consideration of economic problems involved indicate that certain improvements should be considered. These are listed below and are discussed in more detail as part of Plans P-1, P-2 and P-3 in Section III.

a - Production Plant

1 - Restore Otto oven to original capacity by making necessary repairs. Replace missing instruments and gages. Operating savings will result from improved efficiency and decreased labor requirements.

2 - Repair buildings damaged by bombs.

3 - If maximum plant output is increased to the sum of the outputs of Otto oven and horizontal retorts, additional condenser, naphthalene scrubber, ammonia scrubbed and purifiers will be required.

b - Distribution System

1 - Repair mains damaged by bombs - remove restrictions introduced by temporary repair.

2 - New meters are required for those customers not now metered. Use of dry-type meters is to be preferred, and it will be

desirable to replace gradually present wet-type consumer's meters with dry-type meters. The use of dry-type meters will insure greater accuracy of metering and will eliminate labor now required to service wet meters.

3 - If maximum plant output is increased to the sum of the outputs of Otto oven and horizontal retorts - additional new lines and services will be required for the 2000 new customers which can be served.

4 - Description of Property

a - Production Plant

Plant is located in northwest section of Piraeus, with no rail or water facilities, though rail lines are nearby. Plant and related facilities occupy approximately 14,600 m^2. Layout is shown on page 92.

Plant utilizes bituminous coal to produce coal-gas, coke and tar. Equipment includes one Otto vertical oven and six benches of horizontal stop-end retorts.

1 - Otto Oven

There is one Otto vertical oven consisting of two benches of three silica retorts each, with built-in producers, and waste-heat boiler. Unit was built by Pintsch in 1938. Total height of oven unit is 21.2 m. Retorts are 4.3 m high. Recording calorimeter, gages, and other instruments, blowers and pumps are provided. There is a skip hoist for elevating coal, coke and coke breeze. A hand-operated larry is used to distribute coal and coke breeze to retorts and coke to producers. Hot coke is moved to quenching tower by means of hand-operated car. Capacity of coal bin is 45 tons; capacity of coke bin is 13 tons and capacity of breeze bin is 11 tons. Waste-heat boiler operates at pressure of five atmospheres and supplies steam for the unit during the last two hours of carbonizing in order to produce water-gas.

The unit was designed to produce 10,300 m^3 of gas per day with input of approximately 19,350 kg of coal. Normal charge is 2150 kg per retort and normal carbonizing period is 16 hours.

Because of poor maintenance, faulty operation, and low quality coal - all incident to the war - side walls of retorts have become warped so that it is impossible to charge the normal quantity of coal, a longer period is required for carbonizing and much time is lost in freeing the coke which has a tendency to hang up. These factors increase labor costs and decrease efficiency and capacity of unit. Present average charge is approximately 1800 kg and carbonizing time is 19 hours. Under these conditions, the maximum daily output from the unit is approximately 7200 m^3, or 35 per cent lower than design rating.

2 - Horizontal Retorts

There are six benches of seven horizontal stop-end retorts each. Average charge is 120 kg or 265 lb of coal. Retorts are charged using a Bronder charging machine, but coke is removed by hand with rakes. Carbonizing period is 4.8 hours which allows five charges per day per retort. Equipment is reported to have been installed about 1900.

Assuming a charge of 120 kg of coal per retort and a yield of 0.292 m^3/kg (4.7 cu ft/lb), capacity of horizontal retorts is:

7400 m^3 of coal-gas per day with six benches in continuous operation.

6100 m^3 of coal-gas per day with five benches in continuous operation.

3700 m^3 of coal-gas per day with three benches in continuous operation.

Records for 12 months ending March 31 1949 indicate that demands were met with an average of three benches in operation.

3 - Exhausters

Two Pintsch exhausters, each with capacity of 720 m^3, 480 m^3, or 360 m^3 per hour, each driven by three-speed 3-1/2-hp motor; delivery pressure 200 mm of water, connections 250 mm. Installed in 1938.

4 - Condensers

Two condensers, one on exhauster inlet and one on exhauster outlet, capacity of each 10,000 m^3/day. Manufactured by Pintsch and installed in 1938.

No. 1 - 110 m^2 cooling surface; shell 1.2 m diameter, 5.3 m high; 105 tubes, 76 mm diameter x 4.25 m long. Connections 300 mm.

No. 2 - 56 m^2 of cooling surface; shell 0.9 m diameter, 4.6 m high; 56 tubes, 76 mm diameter x 3.6 m long. Connections 250 mm.

Typical condenser temperatures:

	Degrees C
Inlet water	20
Outlet water (winter)	28
Outlet water (summer)	35
Inlet gas	60 - 71
Outlet gas	25

5 - Tar Extractors

Two Pelouze and Audoin 750 mm diameter tar extractors, capacity 10,000 m^3/day each, connections 250 mm. Installed 1938.

6 - Naphthalene Scrubbers

One Pintsch rotary naphthalene scrubber, 1.3 m diameter x 1.5 m long, motor driven, connections 250 mm, capacity 10,000 m^3/day. Installed 1938.

7 - Ammonia Scrubber

One Pintsch rotary ammonia scrubber, 1.5 m diameter x 2.1 m long, motor driven, connections 250 mm, capacity 10,000 m^3/day. Installed 1938.

8 - Purifiers

Six purifiers, water sealed. Cast iron construction; 4.5 m x 3 m x 0.6 m high. Two layers of oxide, 450 kg, connections 400 mm. Capacity 4000 m^3/day each. Installed 1904.

9 - Station Meters

Two meters.

No. 1 - Drum type, Pintsch, capacity 800 m^3/hour, connections 250 mm. Installed 1938.

No. 2 - Drum type, Pintsch, capacity 400 m^3/hour, connections 300 mm. Installed 1904.

10 - Station Governors

Three pressure regulators, Pintsch, 0.9 m, 0.8 m and 0.8 m diameter; connections respectively 250 mm, 200 mm, and 200 mm. Installed 1938.

11 - Tar Still

One tar still, capacity 700 kg of tar per day.

12 - Holders

Two holders, one stripped of steel shell.

No. 1 - 23 m diameter, Belgian manufacture, steel tank, two lifts, pressure 90 mm and 180 mm water, capacity 6000 m^3, connections 500 mm. Installed 1912.

No. 2 - 16.4 m diameter, masonry tank below ground with guide frame, no shell. Connections 250 mm. Installed 1898. Capacity when complete 2450 m^3.

13 - Plant Shops

Meter repair, machine shops. Standby Diesel power plant.

14 - Employees - Plant

Reported to be 63 as of June 1949.

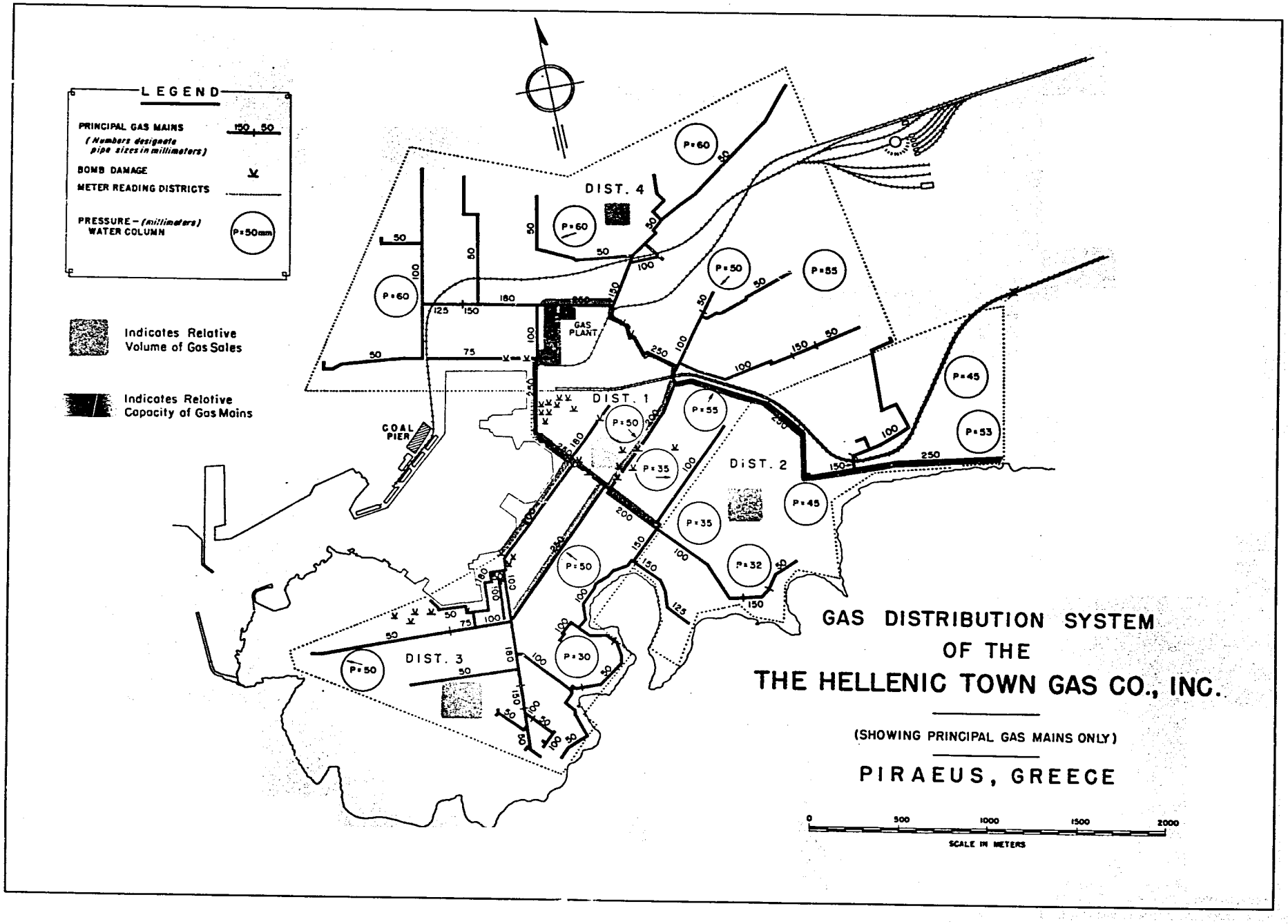
b - Distribution System

The distribution system is shown on map, page 84. This map shows principal lines, location of plant and the four meter-reading districts. It also shows gas pressures existing in the several parts of the system during peak demand in July 1949. It also indicates 32 locations of bomb damage to the distribution system. Generally where damage occurred, repair was made with available pipe - in many cases smaller than that called for. Obstructions to normal gas flow have resulted, which are to be eliminated when proper size pipe is available.

The system consists of approximately 23 km of cast iron and steel pipe 80 - 400 mm diameter and about 72 km of pipe less than 80 mm diameter.

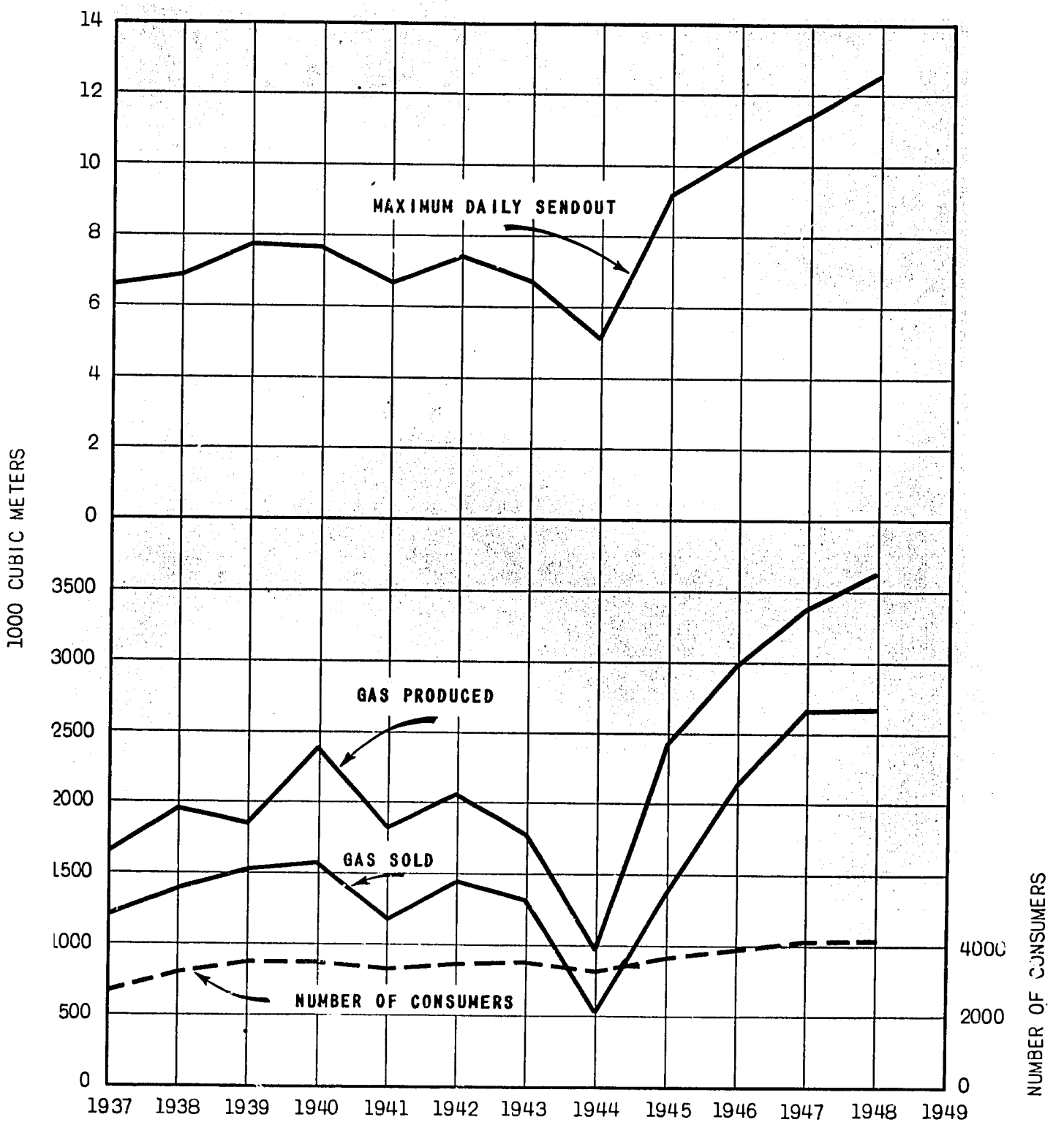
c - Maps and Photographs

A general layout drawing of the gas plant and several views of various parts of the plant are included in pages 92 to 95.


LEGEND
PRINCIPAL GAS MAINS
(Numbers designate pipe sizes in millimeters)
BOMB DAMAGE
METER READING DISTRICTS
PRESSURE – (millimeters) WATER COLUMN
Indicates Relative Volume of Gas Sales
Indicates Relative Capacity of Gas Mains
DIST. 1
DIST. 2
DIST. 3
DIST. 4
GAS PLANT
COAL PIER
GAS DISTRIBUTION SYSTEM
OF THE
THE HELLENIC TOWN GAS CO., INC.
(SHOWING PRINCIPAL GAS MAINS ONLY)
PIRAEUS, GREECE
SCALE IN METERS

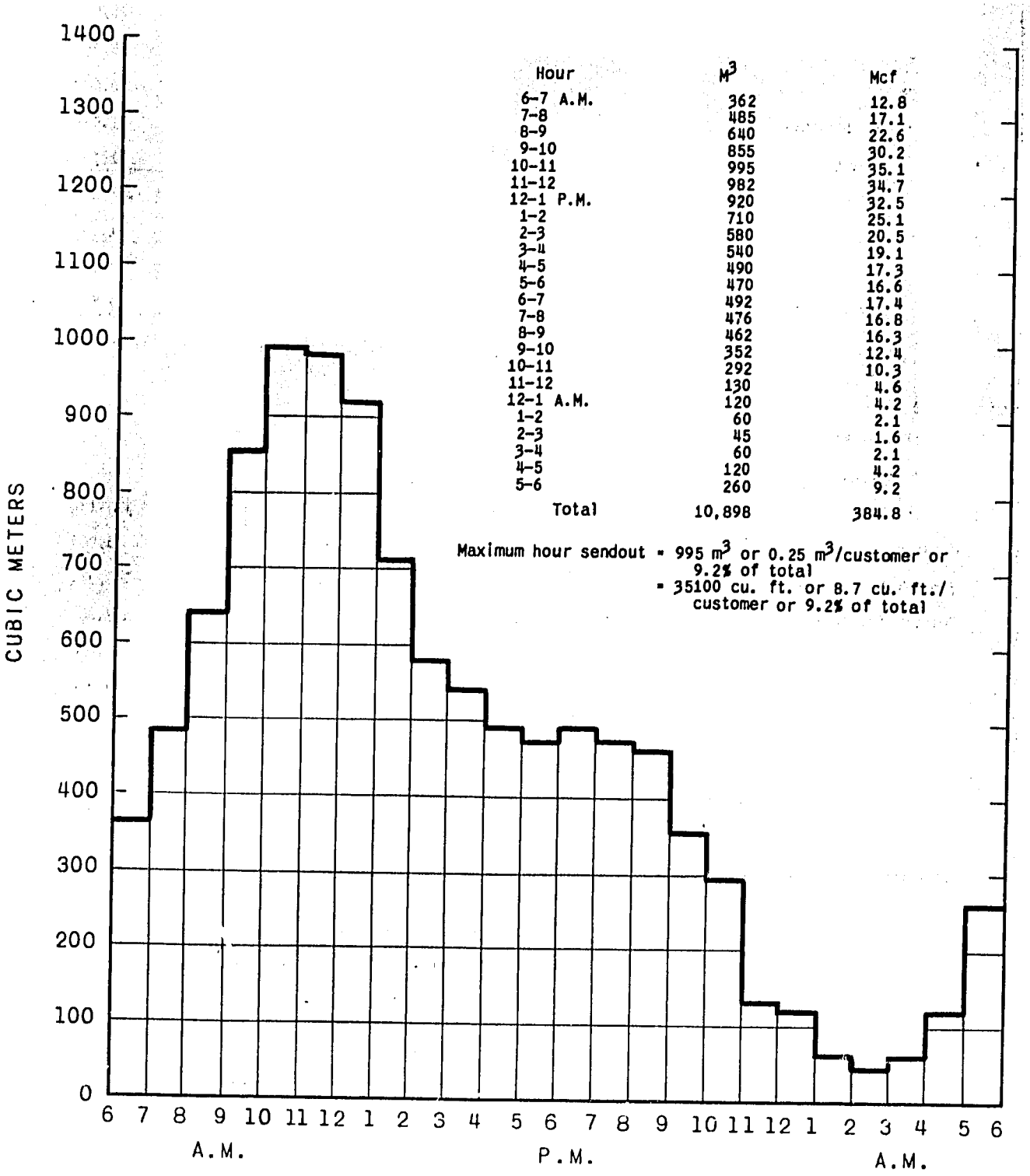
THE HELLENIC TOWN GAS CO., INC.
PIRAEUS, GREECE

GAS PRODUCED AND SOLD, NUMBER OF CONSUMERS
AND MAXIMUM DAILY SENDOUT BY YEARS



THE HELLENIC TOWN GAS CO., INC.
PIRAEUS, GREECE

HOURLY SENDOUT
MARCH 10, 1949
TYPICAL DAY



Hour	M^3	Mcf
6-7 A.M.	362	12.8
7-8	485	17.1
8-9	640	22.6
9-10	855	30.2
10-11	995	35.1
11-12	982	34.7
12-1 P.M.	920	32.5
1-2	710	25.1
2-3	580	20.5
3-4	540	19.1
4-5	490	17.3
5-6	470	16.6
6-7	492	17.4
7-8	476	16.8
8-9	462	16.3
9-10	352	12.4
10-11	292	10.3
11-12	130	4.6
12-1 A.M.	120	4.2
1-2	60	2.1
2-3	45	1.6
3-4	60	2.1
4-5	120	4.2
5-6	260	9.2
Total	10,898	384.8

Maximum hour sendout = 995 m^3 or 0.25 m^3/customer or 9.2% of total
= 35100 cu. ft. or 8.7 cu. ft./customer or 9.2% of total

THE HELLENIC TOWN GAS COMPANY INC
PIRAEUS GREECE
GENERAL BALANCE SHEET
OF DECEMBER 31 1948

		US Dollar Equivalent (10,000 Drachmae per Dollar)
ASSETS		
Buildings and Installations		$ 822,061
Cash and Bank Deposit		10,158
Material Stores		25,646
Stocks		5,952
Debtors		56,607
Provisional Accounts		29,079
Order Accounts		2,169
		$ 951,672
Losses in 1948		71,637
		$1,023,309
Claims for Compensation of Losses		29,570
		$1,052,879
LIABILITIES		
Social Capital (Shares - 80,000)		
On 31-12-1944	1,049	
Readjustment	193,126	$ 194,176
Reserve Fund		3,083
Reserve Fund for Recovery of Capital		104,314
Reserve for the Amortisation of Real Estate and Plant		402,886
Sundry Provisions		20,000
Creditors		168,731
Provisional Accounts		15,741
Order Accounts		2,169
New Readjustment of Currency		112,209
		$1,023,309
Estimate for the Recovery of Losses		29,570
		$1,052,879

Note Data on these sheets were obtained from available sources. Figures were originally in drachmae and, for convenience, have been converted to US dollars on basis of 10,000 drachmae per US dollar.

THE HELLENIC TOWN GAS COMPANY INC
PIRAEUS GREECE
OPERATING REVENUE AND EXPENSE
12 MONTHS ENDING DECEMBER 31 1948

SUMMARY

	US Dollar Equivalent (10,000 Drachmae per Dollar)
Operating Revenue	
Gas - Residential	$142,111
Industrial	74,209
Total	$216,320
Special Charge on Gas	37,411
Meter Rental	18,136
Miscellaneous	1,060
Total Operating Revenue	$272,927
Operating Expense	
Production - Coal Gas	$ 89,602
Storage	2,700
Total	$ 92,302
Distribution	$ 35,550
General and Administrative Expense	$135,181
Taxes	$ 4,711
Total Operating Expense	$267,744
Net from Operation	$ 5,183

DETAILS OF OPERATION
(Dollar Figures Represent US Dollar Equivalent @ 10,000 Drachmae per Dollar)

		Metric Units	English Units
Revenue and Sales			
Revenue per Residential Consumer	$44.12		
Revenue per Industrial Consumer	91.96		
	$53.70		
Sales per Residential Consumer		553.8 m^3	19.55 Mcf
Sales per Industrial Consumer		1096.6 m^3	38.71 Mcf
		662.6 m^3	23.39 Mcf
Average Residential Rate		$0.080/m^3$	$2.26/Mcf
Average Industrial Rate		$0.084/m^3$	2.38/Mcf
		$0.081/m^3$	$2.30/Mcf
Production			
Coal Gas Produced			
Vertical Oven		656 m^3/ton	10.5 cu ft/lb
Horizontal Retorts		449 m^3/ton	7.2 cu ft/lb
Bench Fuel			
Vertical Oven		26.2%	
Horizontal Retorts		18.6%	
Coke Produced		75.2%	
Tar Produced - per ton carbonized		35.7 kg/ton	9.78 gal/2000 l
Heating Value as Distributed		4200 kg-cal/m^3	470 Btu/cu ft
Production Cost - based on gas produced		$0.026/$m^3$	$0.723/Mcf
based on gas sold		$0.035/$m^3$	$0.979/Mcf
Distribution Expense			
Expense per Consumer		$8.83	
General and Administrative Expense			
Expense per Consumer		$33.56	
Number of Consumers			
Residential	3,221		
Industrial	807		
Total	4,028		
Unaccounted-for Gas	26%	944,000 m^3	33,310 Mcf
Unaccounted-for Gas per mile of 3-in. equivalent main			387 Mcf

Note Discrepancies in relationship between amount of coal carbonized and yields of coke and gas can probably be explained by one or more of following factors: errors in inventory, errors in plant metering or delivery of gas having substandard heating value. Accuracy of determination of gas sold and gas unaccounted is, in addition, clouded by fact that there are approximately 300 unmetered consumers.

THE HELLENIC TOWN GAS COMPANY INC
PIRAEUS GREECE
OPERATING REVENUE AND EXPENSE
12 MONTHS ENDING DECEMBER 31 1948
DETAILS
(Dollar Figures Represent US Dollar Equivalent
@ 10,000 Drachmae per Dollar)

			Per m^3 Sold	Per Mcf Sold
Operating Revenue				
Gas - Residential - 1,784,000 m^3	$142,111		$0.080	$2.26
Industrial - 885,000 m^3	74,209		0.084	2.38
Total 2,669,000 m^3	$216,320	$216,320	$0.081	$2.30
Special Charge on Gas		37,411	0.014	0.40
Meter Rental		18,136	0.007	0.19
Miscellaneous		1,060	-	0.01
		$272,927	$0.102	$2.90
			Per m^3 Produced	Per Mcf Produced
Operating Expense				
I - Production				
Vertical Oven - 2,482,000 m^3 produced				
Labor - Salaries	$ 8,200			
Oven Labor	30,018			
	$ 38,218	$ 38,218	$0.015	$0.436
Material				
Coal Carb 3,782 ton @ $16.35	$ 61,868			
Oven Fuel 993 ton @ $35.60	35,347			
Water	363			
Power	154			
Misc	877			
	$ 98,609	$ 98,609	$0.040	$1.125
Maintenance				
Labor	$ 3,800			
Material	4,612			
	$ 8,412	$ 8,412	$0.003	$0.096
Total Labor, Material & Maintenance - Vertical Oven		$145,239	$0.058	$1.657
Horizontal Retorts - 1,131,000 m^3 produced				
Labor				
Salaries	$ 8,200			
Bench Labor	25,247			
	$ 33,447	$ 33,447	$0.030	$0.838
Material				
Coal Carb 2,521 ton @ $16.35	$ 41,245			
Bench Coke 468 ton @ $35.98	16,837			
Water	121			
Power	13			
Misc	1,373			
	$ 59,589	$ 59,589	$0.053	$1.493
Maintenance				
Labor	$ 3,200			
Material	2,612			
	$ 5,812	$ 5,812	$0.005	$0.146
Total Labor, Material & Maintenance - Horizontal Retorts		$ 98,848	$0.088	$2.476
Total Labor, Material & Maintenance for Vertical and Horizontal - 3,613,000 m^3 produced		$244,087	$0.068	$1.914
Exhausters, Purifiers and Misc Equipment				
Labor	$ 4,200			
Power	400			
	$ 4,600	$ 4,600		
Maintenance				
Labor	$ 3,000			
Material	220			
	$ 3,220	$ 3,220		
Total Labor, Material and Maintenance		$251,907	$0.070	$1.974

Note Data on these sheets were obtained from available sources and were not originally in breakdown form presented here. Some rearrangement and allocation has been arbitrarily made, based on study of operation or property. Expense and revenue figures were originally in drachmae but, for convenience, have been converted to US dollars on basis of 10,000 drachmae per US dollar.

PIRAEUS - OPERATING REVENUE AND EXPENSE
CONTINUED

			Per m^3 Produced	Per Mcf Produced
Residual Credit				
Coke produced 4,743 ton @ $33.67		($159,694)		
Tar produced 225 ton @ $33.47		(7,530)		
Breeze 507 ton @ $ 5.97		(3,031)		
		($170,255)		
Residual Operating Expense				
Labor	$ 2,300			
Material and Water	2,200			
	$ 4,500	$ 4,500		
Residual Maintenance Expense				
Labor	$ 2,150			
Material	1,300			
	$ 3,450	$ 3,450		
Net Residual Credit		($162,305)	($0.045)	($1.272)
Net Production Expense		89,602	$0.025	$0.702
Storage				
Maintenance				
Labor	$ 1,200			
Material	1,500			
	$ 2,700	$ 2,700		
Total Production Expense		$ 92,302	$0.026	$0.723
			Per m^3 Sold	Per Mcf Sold
Total Production Expense			$0.035	$0.979
II - Distribution				
Operation				
Labor				
Salaries	$ 8,200			
Operation	8,000			
Meters	2,000			
	$ 18,200	$ 18,200		
Material				
Distribution	$ 1,000			
Meters	400			
	$ 1,400	$ 1,400		
		$ 19,600		
Maintenance				
Labor				
Distribution	$ 11,200			
Meter Repair	2,500			
	$ 13,700	$ 13,700		
Material				
Distribution	$ 1,700			
Meter Repair	550			
	$ 2,250	$ 2,250		
		$ 15,950		
Total Distribution Expense		$ 35,550	$0.013	$0.377
III - General and Administrative Expense				
Labor				
Salaries	$ 16,332			
Office Clerks	76,000			
Total	$ 92,332	$ 92,332		
Direction		$ 10,000		
Military Expense		9,000		
Medical Expense		6,000		
Insurance Expense		2,122		
Cars and Trucks		3,930		
Miscellaneous		11,797		
Total General and Administrative Expense		$135,181	$0.050	$1.435
IV - Taxes		$ 4,711	$0.002	$0.050
Total Operating Expense		$267,744	$0.100	$2.841
Net from Operation		$ 5,183	$0.002	$0.059

( ) indicates credit

THE HELLENIC TOWN GAS COMPANY INC
PIRAEUS GREECE

ANNUAL OPERATING DATA - METRIC UNITS

Year	Annual Production of Gas 1000 m³	Annual Sales of Gas 1000 m³	Gas Lost or Unaccounted 1000 m³	Gas Lost or Unaccounted Per Cent of Production	Maximum Daily Sendout 1000 m³	Load Factor Per Cent	Number of Consumers
1937	1,662	1,200	462	27.8	6.63	69	2,779
1938	1,973	1,398	575	29.1	6.87	79	3,223
1939	1,851	1,524	327	17.7	7.79	65	3,520
1940	2,318	1,559	759	32.7	7.68	83	3,550
1941	1,803	1,178	625	34.7	6.72	74	3,314
1942	2,054	1,440	614	29.9	7.40	76	3,495
1943	1,763	1,303	460	26.1	6.78	71	3,549
1944	957	501	456	47.6	5.05	52	3,270
1945	2,419	1,371	1,048	43.4	9.18	72	3,623
1946	2,996	2,136	860	28.8	10.38	79	3,813
1947	3,392	2,659	733	21.6	11.40	82	4,005
1948	3,613	2,667	946	26.2	12.50	79	4,065
	26,801	18,936	7,865	29.4			

ANNUAL OPERATING DATA - ENGLISH UNITS

Year	Annual Production of Gas Mcf	Annual Sales of Gas Mcf	Gas Lost or Unaccounted Mcf	Gas Lost or Unaccounted Per Cent of Production	Maximum Daily Sendout Mcf	Load Factor Per Cent	Number of Consumers
1937	58,690	42,370	16,320	27.8	234.1	69	2,779
1938	69,670	49,360	20,310	29.1	242.6	79	3,223
1939	65,360	53,810	11,550	17.7	275.1	65	3,520
1940	81,850	55,050	26,800	32.7	271.2	83	3,550
1941	63,660	41,600	22,060	34.7	237.3	74	3,314
1942	72,530	50,850	21,680	29.9	261.3	76	3,495
1943	62,250	46,010	16,240	26.1	239.4	71	3,549
1944	33,790	17,690	16,100	47.6	178.3	52	3,270
1945	85,410	48,410	37,000	43.4	324.1	72	3,623
1946	105,790	75,420	30,370	28.8	366.5	79	3,813
1947	119,770	93,890	25,880	21.6	402.5	82	4,005
1948	127,580	94,170	33,410	26.2	441.4	79	4,065
	946,350	668,630	277,720	29.4			

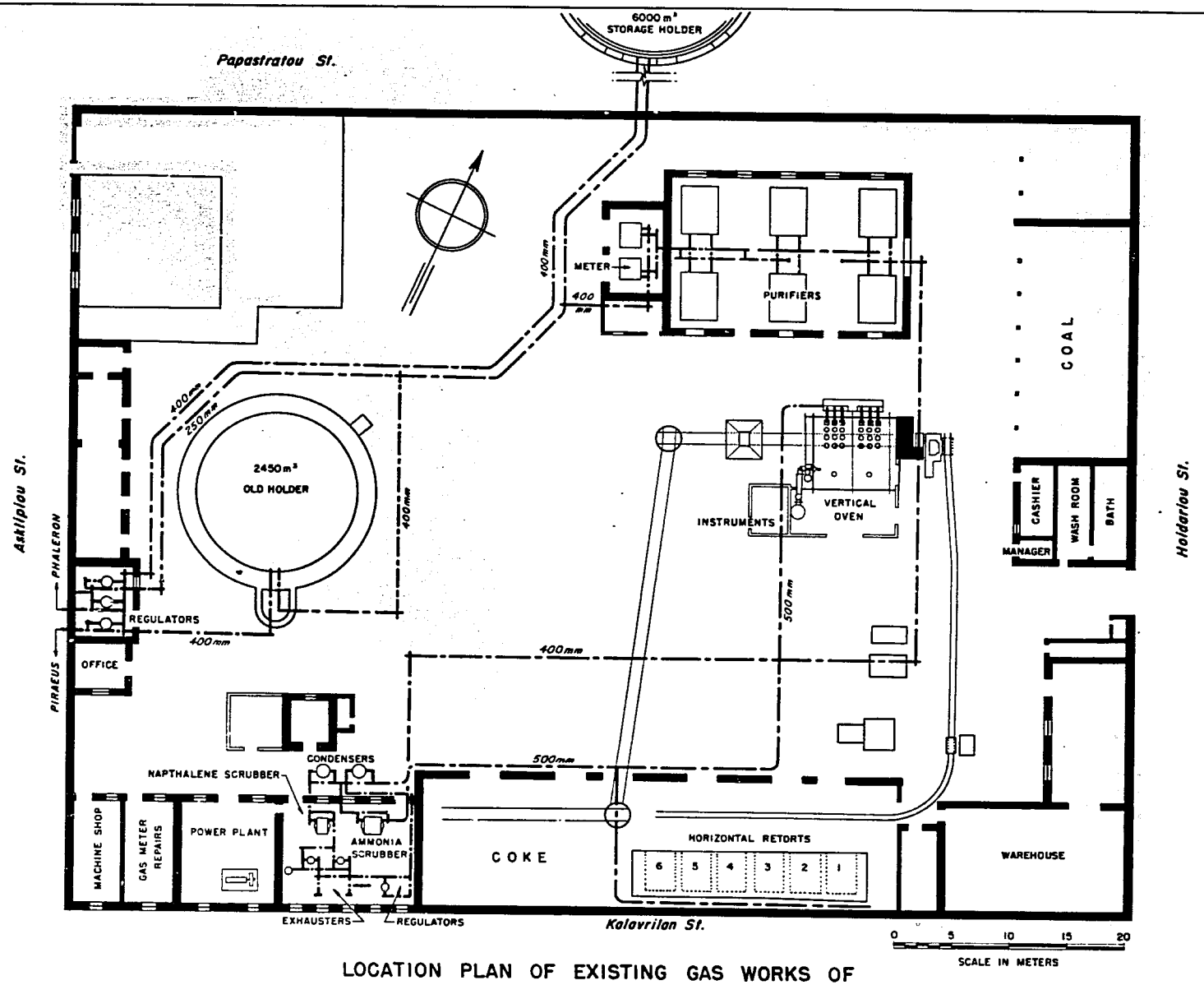
OPERATING DATA - METRIC UNITS
12 MONTHS ENDING DECEMBER 31 1948

	Coal Carbonized Metric Tons	Coke Produced Metric Tons	Tar Produced Metric Tons	Gas Produced 1000 m³ (Coal Gas)	Gas Sold - 1000 m³ Residential	Gas Sold - 1000 m³ Commercial and Industrial	Gas Sold - 1000 m³ Total	Gas Lost or Unaccounted 1000 m³	Gas Lost or Unaccounted Per Cent of Production
January 1948	-	-	-	314	157	78	235	79	25.2
February 1948	-	-	-	294	153	70	223	71	24.2
March 1948	-	-	-	317	163	77	240	77	24.3
April 1948	-	-	-	311	162	73	235	76	24.4
May 1948	-	-	-	302	153	72	225	77	25.5
June 1948	-	-	-	288	148	73	221	67	23.3
July 1948	-	-	-	275	130	71	201	74	26.9
August 1948	-	-	-	267	114	69	183	84	31.4
September 1948	-	-	-	269	132	71	203	66	24.5
October 1948	-	-	-	304	146	72	218	86	28.3
November 1948	-	-	-	313	154	76	230	83	26.5
December 1948	-	-	-	359	172	83	255	104	29.0
	6,300	5,250	188	3,613	1,784	885	2,669	944	26.1

OPERATING DATA - ENGLISH UNITS
12 MONTHS ENDING DECEMBER 31 1948

	Coal Carbonized Short Tons	Coke Produced Short Tons	Tar Produced Short Tons	Gas Produced Mcf (Coal Gas)	Gas Sold - Mcf Residential	Gas Sold - Mcf Commercial and Industrial	Gas Sold - Mcf Total	Gas Lost or Unaccounted Mcf	Gas Lost or Unaccounted Per Cent of Production
January 1948	-	-	-	11,080	5,540	2,750	8,290	2,790	25.2
February 1948	-	-	-	10,380	5,400	2,470	7,870	2,510	24.2
March 1948	-	-	-	11,190	5,760	2,720	8,480	2,710	24.3
April 1948	-	-	-	10,980	5,720	2,580	8,300	2,680	24.4
May 1948	-	-	-	10,660	5,400	2,540	7,940	2,720	25.5
June 1948	-	-	-	10,170	5,230	2,580	7,810	2,360	23.3
July 1948	-	-	-	9,710	4,590	2,510	7,100	2,610	26.9
August 1948	-	-	-	9,430	4,030	2,440	6,470	2,960	31.4
September 1948	-	-	-	9,500	4,660	2,510	7,170	2,330	24.5
October 1948	-	-	-	10,730	5,160	2,540	7,700	3,030	28.3
November 1948	-	-	-	11,050	5,440	2,680	8,120	2,930	26.5
December 1948	-	-	-	12,680	6,070	2,930	9,000	3,680	29.0
	6,989	5,800	207	127,560	63,000	31,250	94,250	33,310	26.1

Discrepancies in relationship between amount of coal carbonized and the yields of coke and gas can probably be explained by one or more of the following factors: errors in inventory, errors in plant metering or delivery of gas having substandard heating value. Accuracy of determination of gas sold and gas unaccounted is, in addition, clouded by fact that there are approximately 300 unmetered consumers.

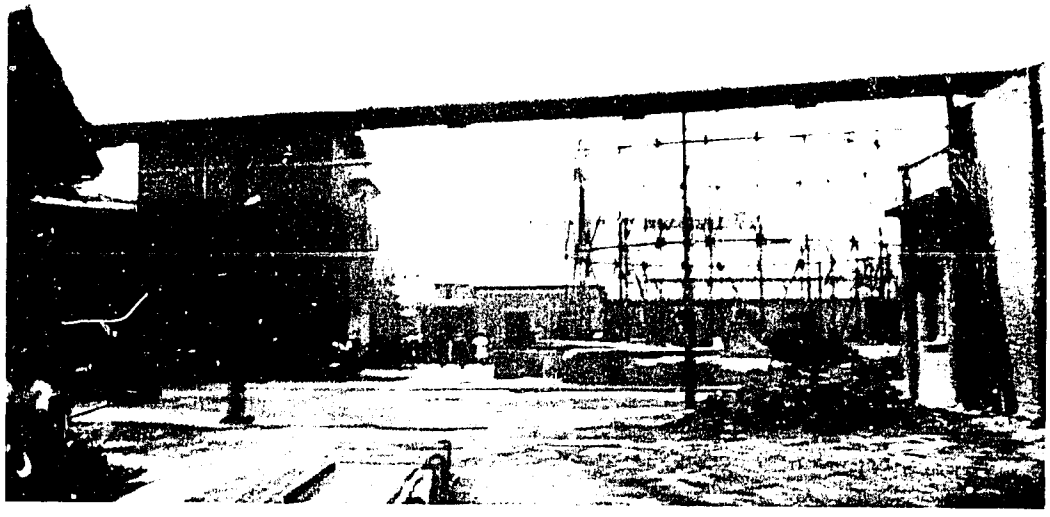


LOCATION PLAN OF EXISTING GAS WORKS OF

THE HELLENIC TOWN GAS CO., INC.

PIRAEUS, GREECE

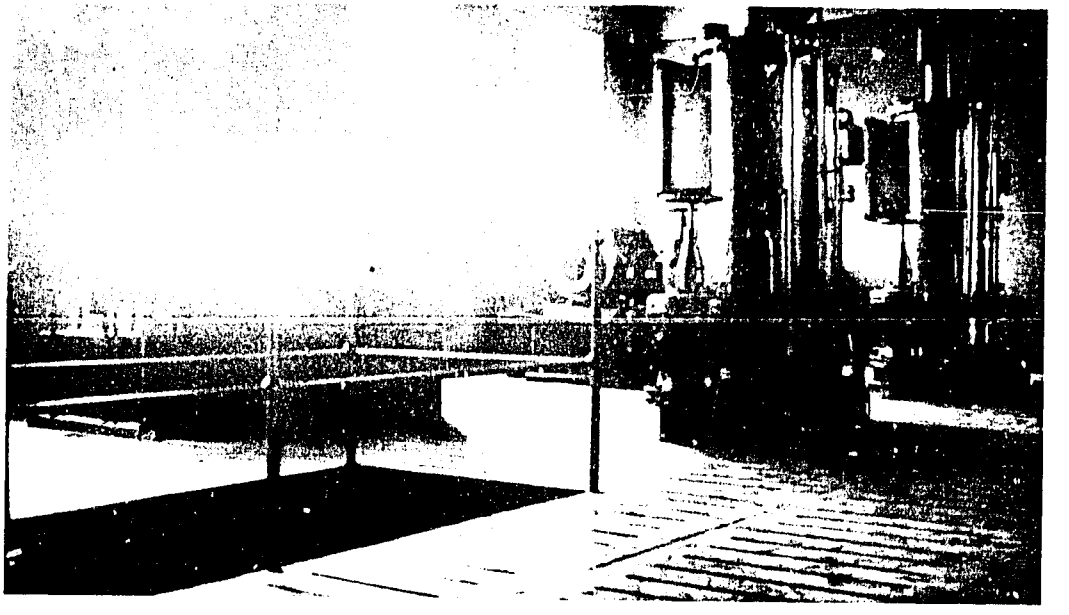
THE HELLENIC TOWN GAS COMPANY INC
PIRAEUS GREECE



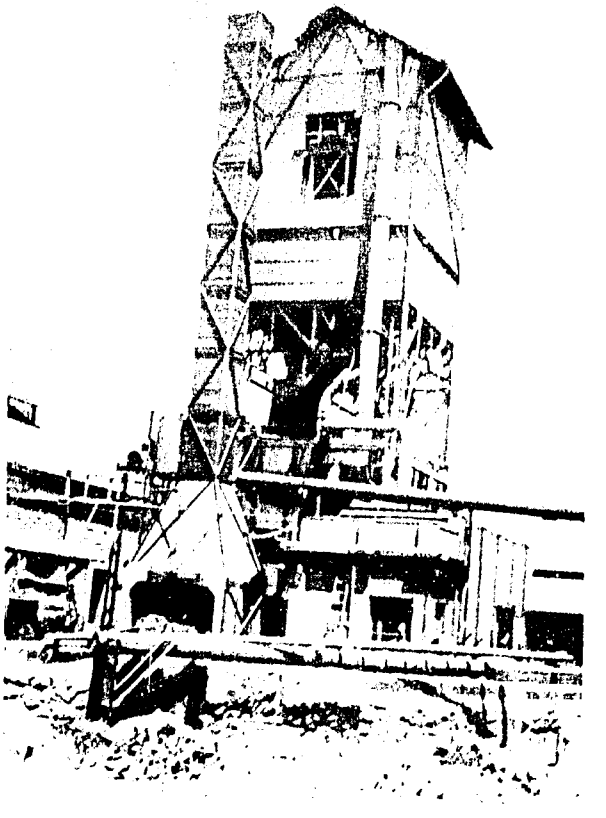
Horizontal Retort House
Plant Office
Abandoned Holder

Condensers

THE HELLENIC TOWN GAS COMPANY INC
PIRAEUS GREECE

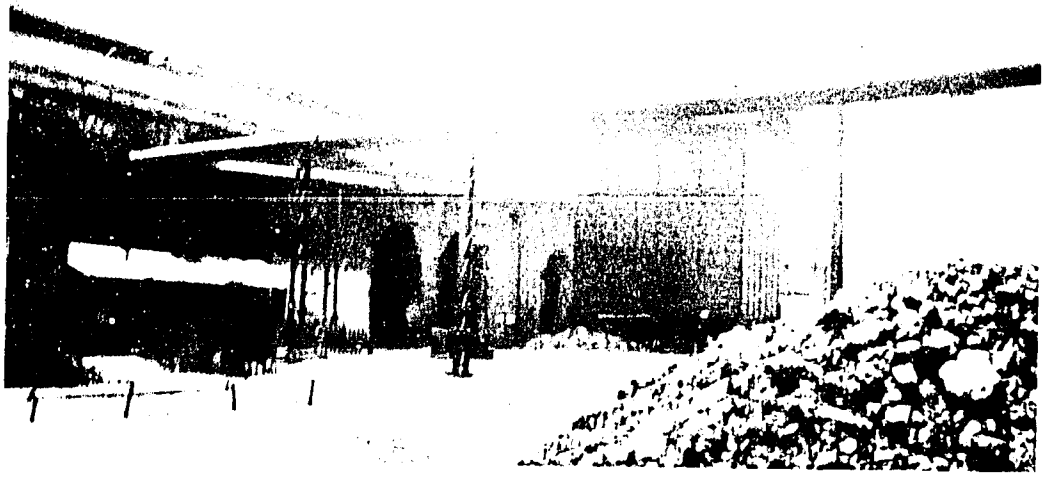


Exhausters
and Tar Extractors

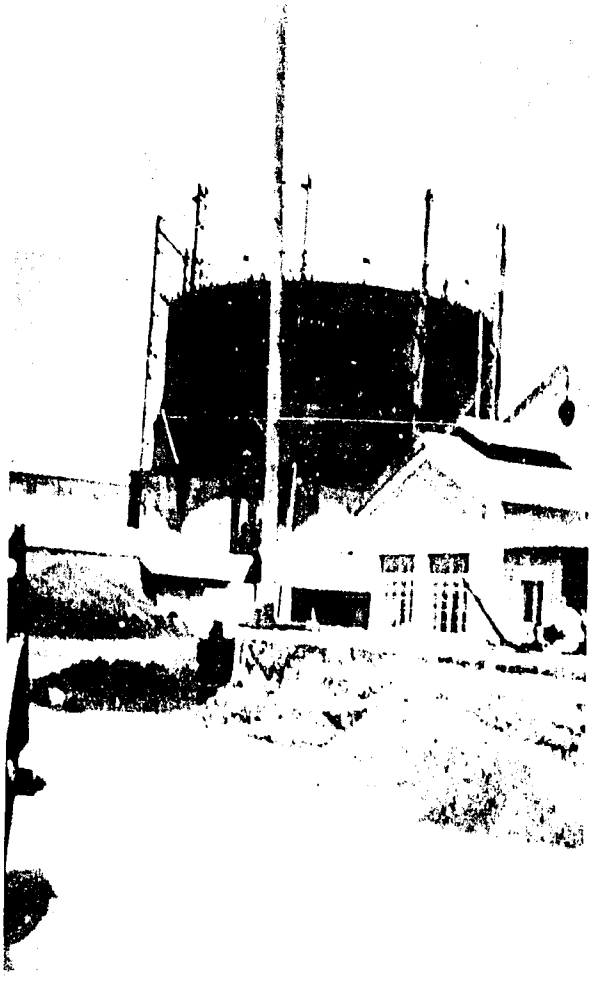


Vertical Otto Oven

THE HELLENIC TOWN GAS COMPANY INC
PIRAEUS GREECE



Retort House
and Tar Still



6000 m^3 Storage Holder

C - CITY OF PATRAS - GAS DEPARTMENT

1 - General

The production plant and gas distribution system in Patras is owned by the city of Patras. The property has an estimated present value of $110,000. Facilities have been idle since November 25 1939, when they were closed down because of wartime fuel shortages. At that time the annual production was 665,000 m^3 and 1135 consumers were served. A general description of the property appears in pages 98 to 100.

Patras had a population of 79,000 persons in 1940 and the present population is estimated to be 87,000.

2 - Operations

a - Production

Gas plant consists of (1) a vertical Otto oven installed in 1929 with a design capacity of 3600 m^3 (127 Mcf) of coal-gas per day and (2) six benches of horizontal stop-end retorts having a maximum capacity of approximately 4900 m^3 (173 Mcf) of coal-gas per day.

Plant has suffered some damage from bombing, some deterioration resulting from idleness and some loss of motors, instruments and miscellaneous parts which were reported to have been removed by the Germans during the occupation.

The Otto oven is in generally good condition but repairs to the coal handling equipment are required and new exhausters, condensers, meter and station governor must be provided if plant is to operate again. The gas holder has its crown collapsed and has shrapnel holes, but can be repaired. Coal pier which served the plant has been destroyed by bombing and must be rebuilt if coal is to be received by water.

Of the horizontal retorts, only four benches are suitable for rehabilitation.

b - Distribution

As may be seen from the map on page 101, the city was supplied by a well designed system with mains of a larger size than are

usually found in a city of similar size. A 150 mm cast iron bell and spigot joint in eastern part of system was examined in June 1949 and jute packing was found to be in good condition.

Both wet- and dry-type meters were used and presumably all of these are in warehouse storage. Condition of many of them is doubtful and it is estimated that possibly 200 meters can be rehabilitated out of the 600 oil- or water-sealed meters and 300 dry meters in storage.

3 - Rehabilitation

It is considered that facilities can be rehabilitated and system operated to supply approximately 2000 consumers. The following repairs will be required. These items are considered in further detail as part of Plan B-1 in Section III.

a - Production Plant

1 - Replace missing equipment on Otto oven and rehabilitate for service.

2 - Repair horizontal retorts.

3 - Provide and install two exhausters, one condenser, one station meter and one station governor.

4 - Repair gas holder.

5 - Repair coal pier and track.

6 - Repair buildings damaged by bombs

b - Distribution System

1 - Inspect and repair 1200 services and install 600 new services.

2 - Provide and install 1800 new consumers' meters - dry type.

3 - Make miscellaneous gas main repairs.

4 - Description of Property

a - Production Plant

Plant is located west of city on Bay of Corinth, and facilities occupy approximately 4940 m^2.

Plant has not operated since November 1939, when it was closed down because of wartime fuel shortage. Since then, plant has suffered some damage from bombing, some deterioration resulting from idleness and some loss of motors, instruments and miscellaneous parts which were removed, reportedly by the Germans.

Plant utilized bituminous coal to produce coal-gas. Equipment includes one Otto vertical oven and six benches of horizontal stop-end retorts.

1 - Otto Oven

There is one Otto vertical oven, installed in 1929, consisting of one bench of three silica retorts, with built-in producer and waste-heat boiler. Total height of oven unit is 11.5 m. There is a skip hoist for elevating coal, coke and coke breeze, but motor and cable are missing. Instruments and various blowers and pumps are missing. Overhead bin has compartments for coal and coke breeze for retorts and coke for producer. Capacity of coal bin is ten tons. Unit includes a coke car and track.

New retorts were installed in 1939 and retorts and producer are in good condition.

Unit was designed to produce 3600 m^3 of coal-gas per day with daily input of approximately 6800 kg of coal. Normal charge is 2150 kg per retort and normal carbonizing period is 23 hours.

2 - Horizontal Retorts

There are six benches of seven horizontal stop-end retorts each. Average charge was 120 kg or 264 lb of coal. Carbonizing period was 4.8 hours which allows five charges per day per retort. Date of installation is unknown but equipment is quite old. Iron

work including mouthpieces, doors, etc is in fair condition. Only four benches are suitable for rehabilitation.

Assuming an average charge of 120 kg of coal per retort and a yield of 0.292 m^3/kg (4.7 cu ft/lb), capacity of horizontal retorts is

4910 m^3 of coal-gas per day with four benches in continuous operation.

3680 m^3 of coal-gas per day with three benches in continuous operation.

2450 m^3 of coal-gas per day with two benches in continuous operation.

3 - Exhausters

Two exhausters, originally motor driven but motors missing, connections 250 mm. Poor condition necessitates replacement if plant is to be operated.

4 - Condensers

Two condensers, 1.3 m diameter x 3.8 m high and 1.1 m diameter x 4.6 m high, connections 250 mm. Poor condition necessitates replacement if plant is to be operated.

5 - Naphthalene Scrubber

One rotary naphthalene scrubber, 2 m diameter x 1.3 m long. Formerly belt driven from shaft, but shaft and driving motor are missing. Connections 250 mm.

6 - Ammonia Scrubber

One rotary ammonia scrubber, 1.3 m diameter x 2 m long. Formerly driven by same drive used for naphthalene scrubber.

7 - Purifiers

Four purifiers, water sealed. Cast iron construction with steel tops; 4 m x 4.9 m x 0.7 m. Amount of oxide required not known. Capacity not known. Manufacturer Siry-Lizars, Milan Italy.

8 - Station Meter

One meter, drum type 1.8 m diameter x 1.8 m long, connections 250 mm. Capacity unknown. Poor condition necessitates replacement if plant is to be operated.

9 - Holder

One holder, in fair condition but crown is collapsed and has shrapnel hole; 20.5 m diameter, two lifts, capacity 3300 m^3, connections 250 mm.

10 - Coal Pier

Destroyed by bombing. Must be replaced if coal is to be delivered to plant by water - otherwise a three kilometer truck haul from railroad yards will be required for delivery.

b - Distribution System

City is supplied by a system that appears to be properly laid out and sized. The distribution map is shown on page 101. There were 1135 consumers in 1939.

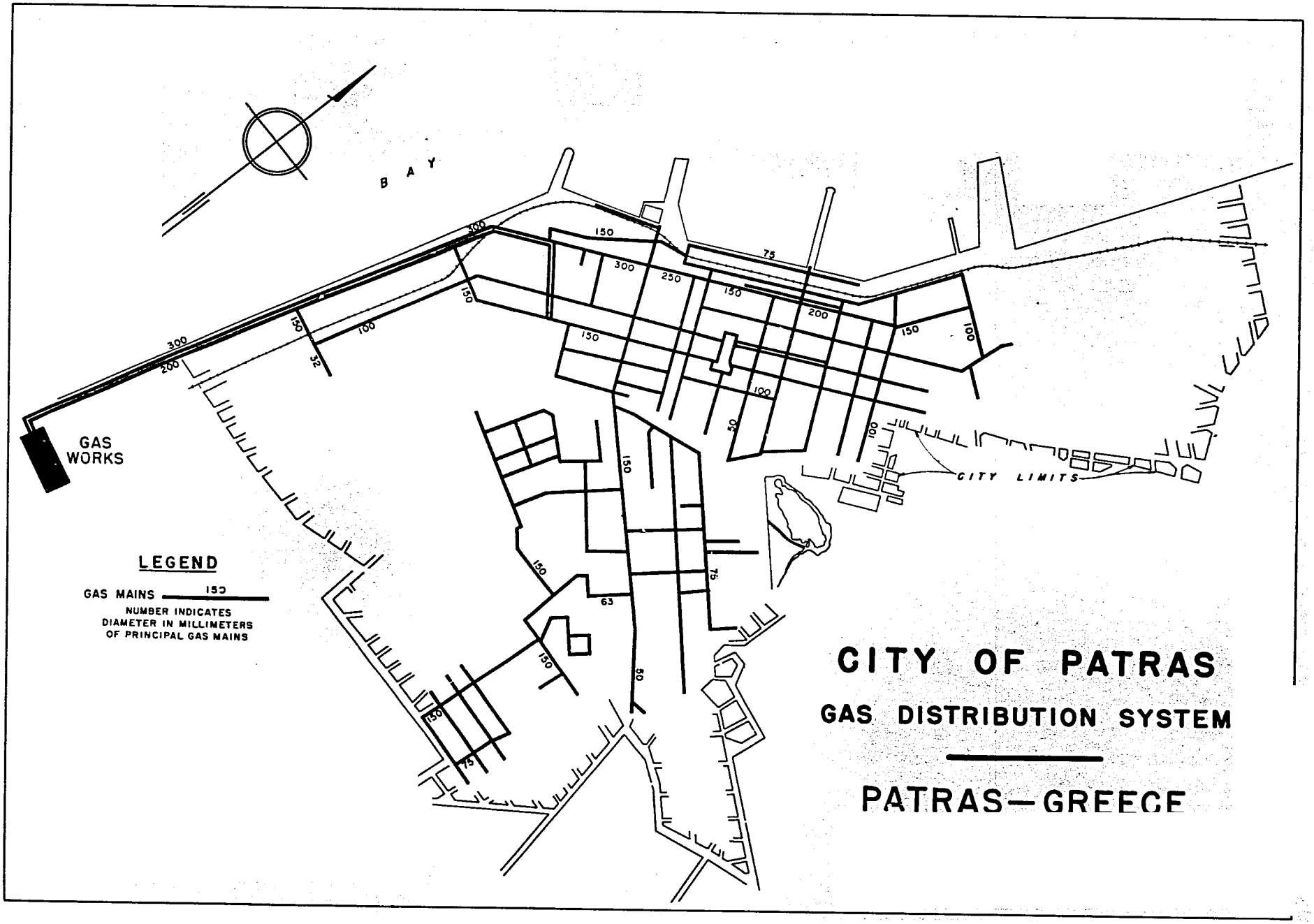
There are approximately 30 km of lines or approximately 26.5 linear meters per consumer (as of 1939). Of this total, approximately 19 km are under 80 mm and 11 km are from 80 mm to 300 mm in diameter. A 150 mm cast iron bell and spigot joint in eastern part of system was examined in June 1949 and jute packing found to be in good condition.

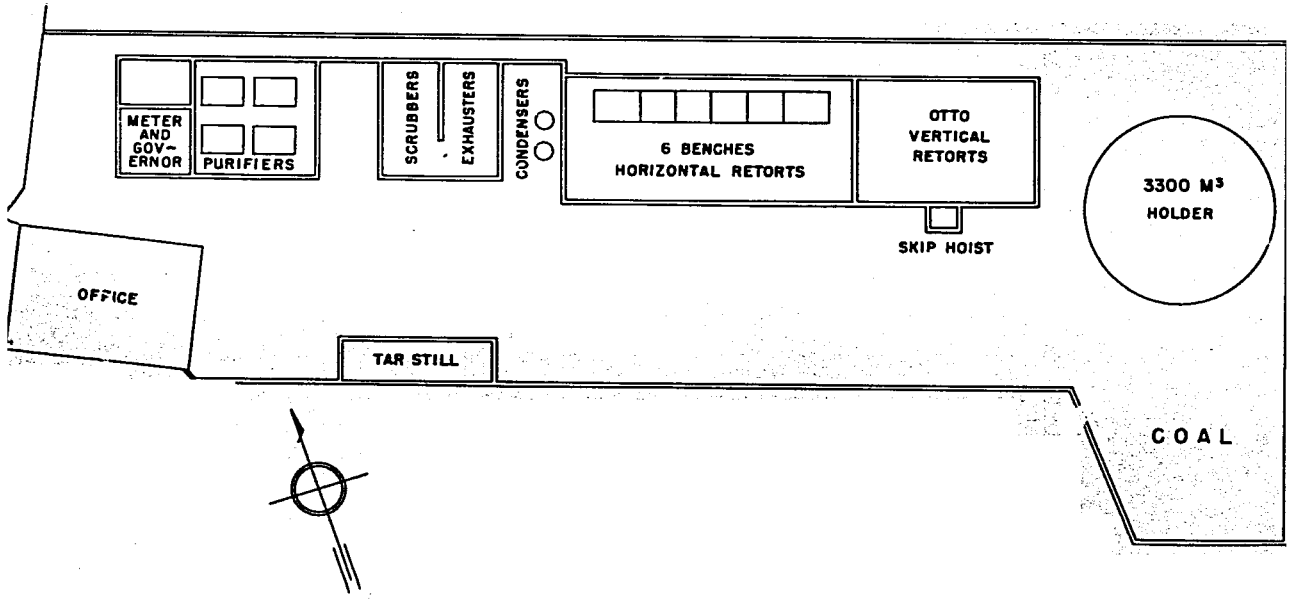
1 - Meters

Both dry- and wet-type meters were used and presumably all are now in storage in warehouse. Condition of many of them is doubtful and it is estimated that possibly 200 meters can be rehabilitated out of the 600 oil- or water-sealed and 300 dry meters in storage.

c - Maps and Photographs

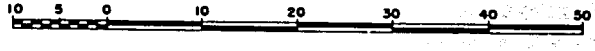
General layout drawings of gas plant and distribution system and several views of gas plant and city are included on the following pages.


CITY OF PATRAS
GAS DISTRIBUTION SYSTEM
PATRAS—GREECE
GAS WORKS
B A Y
CITY LIMITS
LEGEND
GAS MAINS 150
NUMBER INDICATES DIAMETER IN MILLIMETERS OF PRINCIPAL GAS MAINS



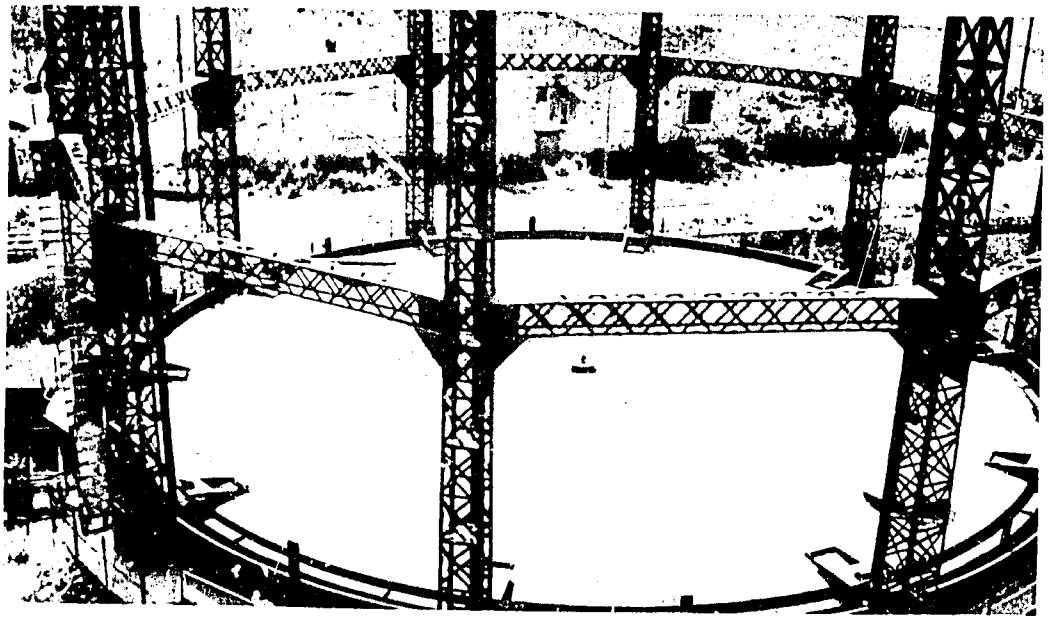
LOCATION PLAN OF EXISTING GAS WORKS OF THE · CITY · OF · PATRAS

SCALE IN METERS



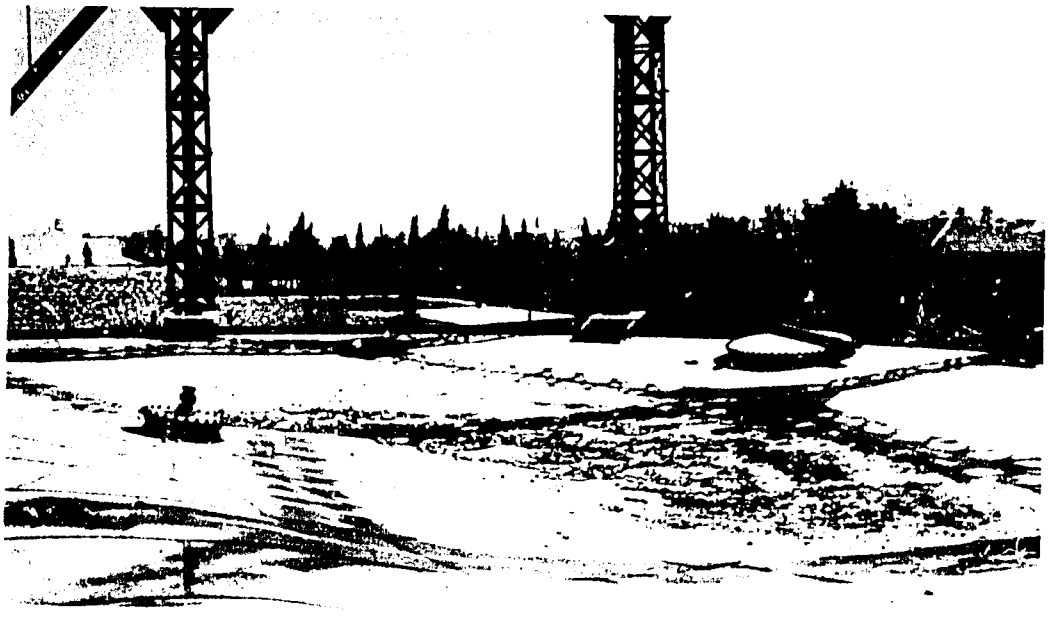
CITY OF PATRAS
PATRAS GREECE
GAS DEPARTMENT

Plant Buildings - Retort House on Right



Storage Holder - 3300 m^3 Capacity

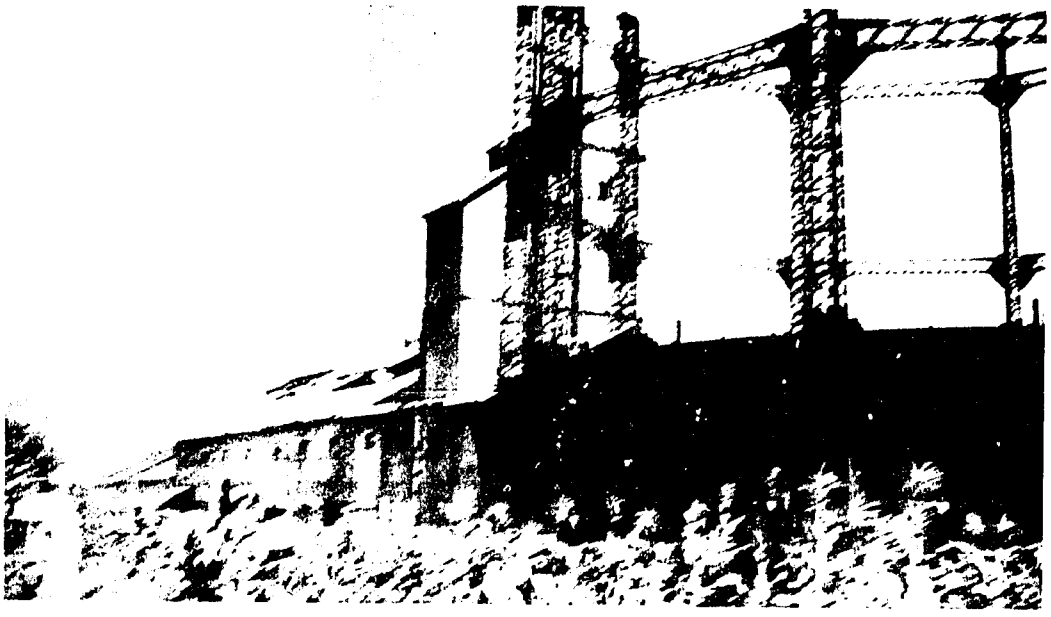
CITY OF PATRAS
PATRAS GREECE
GAS DEPARTMENT



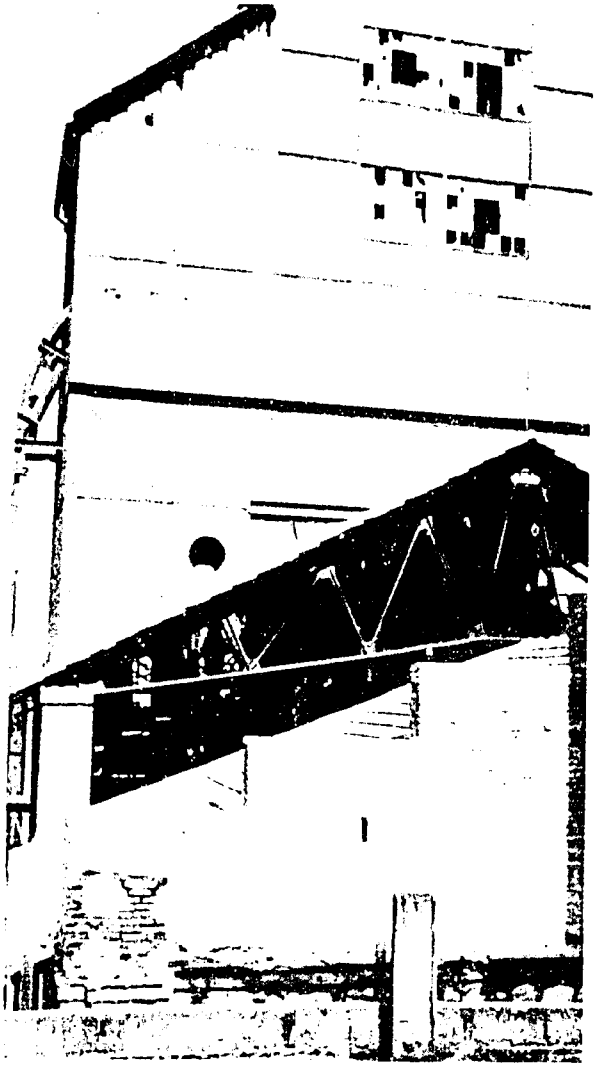
Crown of Storage Holder

View of Damaged Roof of Retort, Scrubber and Purifier House

Damaged Coal Pier Beyond

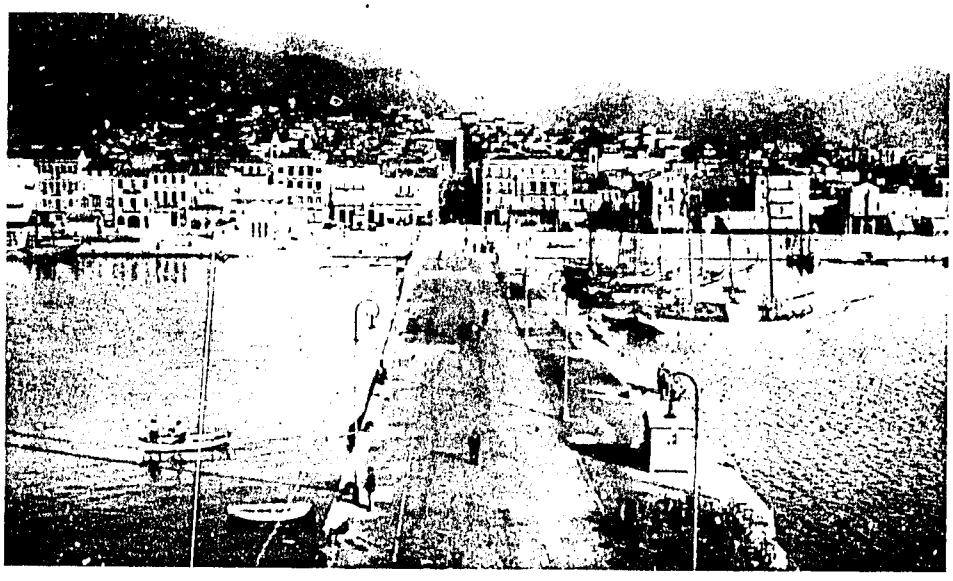


General View of Holder,
Vertical Oven and Plant



Portion of Vertical Oven
Skip Hoist at Left

CITY OF PATRAS
PATRAS GREECE
GAS DEPARTMENT



View of City

View of City

D - CITY OF SALONIKA - GAS DEPARTMENT

1 - General

In 1917 the western section of the city was destroyed by fire. This area included practically all the consumers of the then existing gas company and gas plant was abandoned.

2 - Production Plant

Plant was located at a point four kilometers west of center of city in what is now the industrial section. Plant consisted of horizontal stop-end retorts for the production of coal-gas. Little is known of its size except that holder had capacity of 5050 m^3. Based on practice, it is probable that plant had a capacity of 8000 - 10,000 m^3/day. A brick stack and foundation of the holder are only remaining parts of plant. The old retort house is now used as a city warehouse and three additional buildings have been erected on the site. Site is irregular in shape and dimensions are 132 m x 118 m x 137 m x 100 m. There is also a right of way 15 m wide x 183 m extending to the bay where a coal pier was formerly located.

3 - Distribution System

There is no available record of location, size or length of the various distribution mains and city officials advised that some had been removed when pavement was laid.

4 - Rehabilitation

Rehabilitation appears to be out of the question. In the first place, there is nothing left of the production plant except the site. The distribution system, even though it were found in good condition, which is highly improbable, would be inadequate for present-day requirements. To provide manufactured gas in Salonika, a complete new production plant and distribution system would be required.

5 - Description of Property

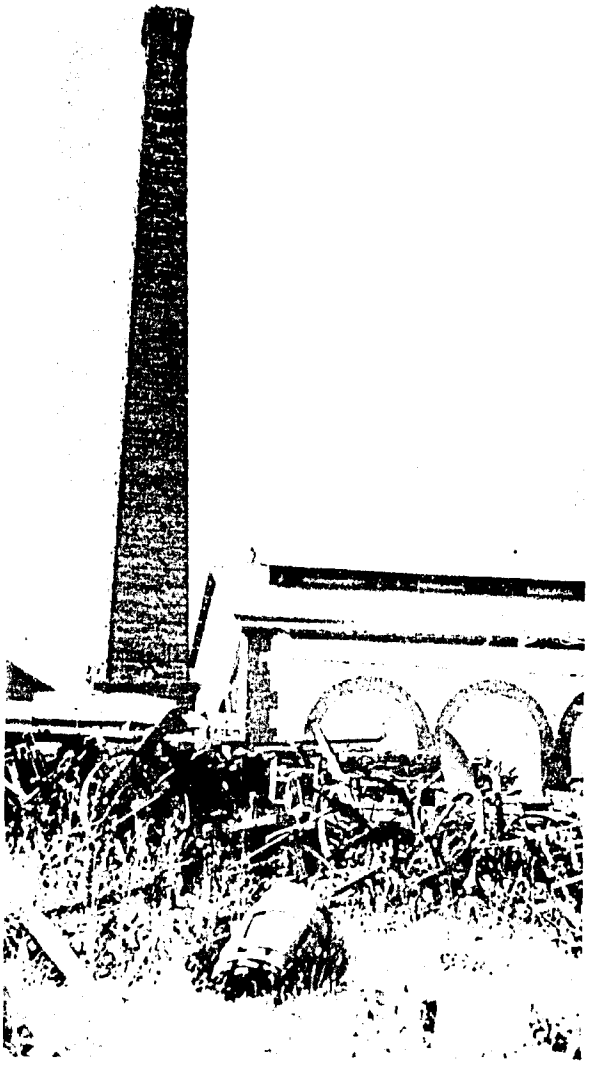
There are no data available other than that given above.

a - Photographs

Two photographs on following page indicate present state of production plant.

CITY OF SALONIKA
SALONIKA GREECE
GAS DEPARTMENT

Foundation and
Part of Guide Frame
of Former Gas Holder



Retort Stack
Former Retort House Now
Used as Warehouse

E - CITY OF VOLOS - GAS DEPARTMENT

1 - General

The city of Volos had a population of 55,000 in 1940 and present population is estimated to be approximately 60,000.

The production plant and distribution system are owned by the city of Volos and were operated by a concessionaire until 1939, when plant was closed because of wartime fuel shortage. General description of property is given in pages 110 to 112.

Operating data for years 1935 - 1938 are shown below. Sales per consumer were very low and unaccounted gas was very high.

Year	1935	1936	1937	1938
Number of Consumers (Average)	634	658	724	769
Coal Used - Metric Tons	1234	1234	1234	1479
Gas Produced - 1000 m^3	344	351	366	435
Gas Produced - m^3/Metric Ton	279	285	297	294
Gas Sold - 1000 m^3	202	212	219	245
Gas Sold - m^3/Consumer	319	320	303	319
Gas Unaccounted for - %	41	40	40	44

2 - Production Plant

As a result of the war, there is very little left of the plant. Most of the iron work of the retorts, one entire holder, and most of the principal equipment has disappeared. The retorts are useless, the brick stack is about to fall and a complete new plant is required if gas is to be produced.

3 - Distribution System

The mains were installed about 1905 and have been out of service for ten years. A 150 mm bell and spigot joint was examined in June 1949 and it was found that sealing jute had deteriorated to dust. The gas leakage was very high when the property discontinued operation and it is probable that many joints would have to be repaired before resuming operation.

4 - Rehabilitation

The condition of production plant precludes its rehabilitation. A new production plant and the repair of the existing distribution system would be expensive. The limited number of potential consumers and the fact that the city has no water system (thereby eliminating the revenue from water heating) makes it extremely doubtful that a manufactured gas system for Volos can be justified.

5 - Description of Property

a - Production Plant

Plant is located in western section, approximately one kilometer from center of city. Plant and related facilities occupied 10,130 m^2. In June 1949 most of the buildings and area were being used to house war refugees.

Plant was built in the period 1887 - 1900. It has not operated since 1939 when it was closed because of wartime fuel shortage. The plant has suffered deterioration from idleness and considerable loss of equipment which was removed by the Germans.

Plant utilized bituminous coal to produce coal-gas.

1 - Coal-Gas Manufacture

There are six benches, or groups of retorts, with direct-fired furnaces. Each bench contains seven horizontal stop-end retorts, 2.1 m long. Retorts were found to be useless and beyond economic rehabilitation. Most of the iron has been stripped and such parts that remain, including brickwork, are in extremely poor condition. Brick chimney, 24 m high and 3.3 m x 3.3 m at base is leaning and appears about to collapse. It was reported to have been shaken by bombing in 1940.

Units probably produced 6000 - 7000 m^3 of coal-gas per day when plant was operating, based on an estimated normal charge of 100 kg of coal per retort and a four-hour carbonizing period.

2 - Exhausters

Two exhausters, French manufacture, capacity unknown, belt driven by one horizontal internal combustion engine which used coal-gas for fuel.

3 - Condensers

Two condensers, 1 m diameter x 4.5 m high and 0.8 m diameter x 4.5 m high. There is no regular town water supply, and these condensers were cooled by pumping spring water. Pumps, now missing, were driven by belts from the exhausters.

4 - Ammonia Scrubbers

Two ammonia scrubbers, 1.2 m and 0.9 m diameter x 4.5 m high. Connections 230 mm. Very poor condition.

5 - Purifiers

Four purifiers, water sealed. Cast iron construction, 2.4 m x 3.3 m x 1.3 m. Connections 230 mm. Amount of oxide not known. Capacity not known. Very poor condition.

6 - Station Meter

One drum type, French manufacture, 0.9 m diameter x 0.9 m long. Connections 230 mm. Capacity not known.

7 - Station Governor

Very poor condition.

8 - Holders

Two holders.

No. 1 - 16.5 m diameter, masonry tank, single lift, connections 230 mm. Steel shell has been stripped. Original capacity 1200 m^3.

No. 2 - 12.5 m diameter, masonry tank, single lift, connections 180 mm. Top split. Capacity 500 m^3.

b - Distribution System

System is reported to have included approximately 20 km of pipe, with sizes ranging up to 250 mm diameter.

Mains were installed beginning about 1900 and have not been used since 1939. A 150 mm cast iron bell and spigot joint of older vintage was taken apart and it was found that the jute packing had crumbled to dust. This condition undoubtedly exists in many other old joints. It is extremely doubtful that joints in such condition can be made gas tight without recaulking or clamping.

: - Photographs

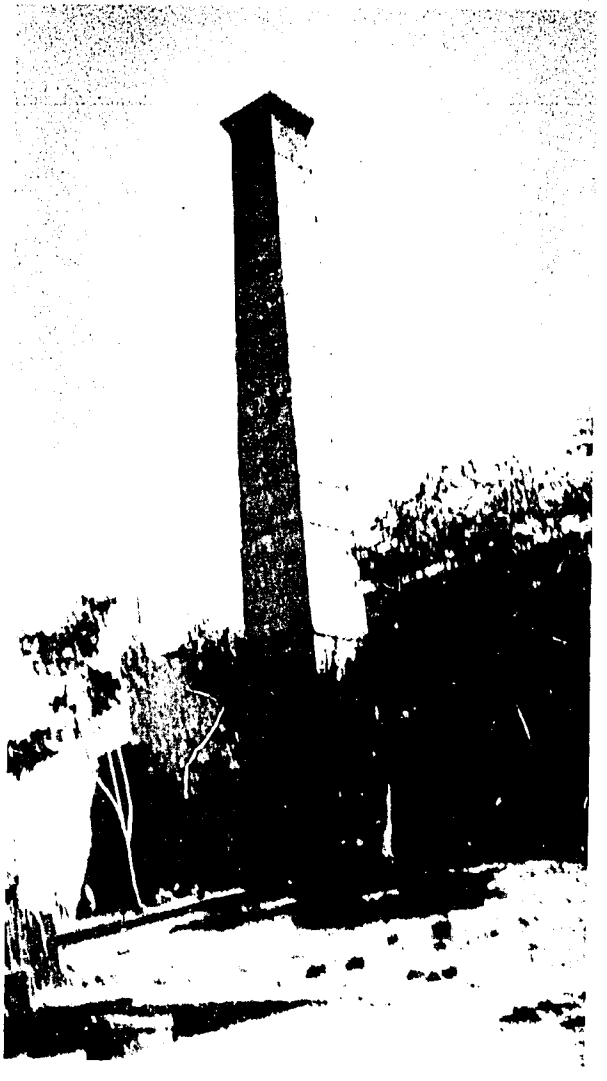
Several photographs showing condition of gas plant are included on the following pages.

CITY OF VOLOS
VOLOS GREECE
GAS DEPARTMENT

View of Retort House

Gas Holders and Meter House

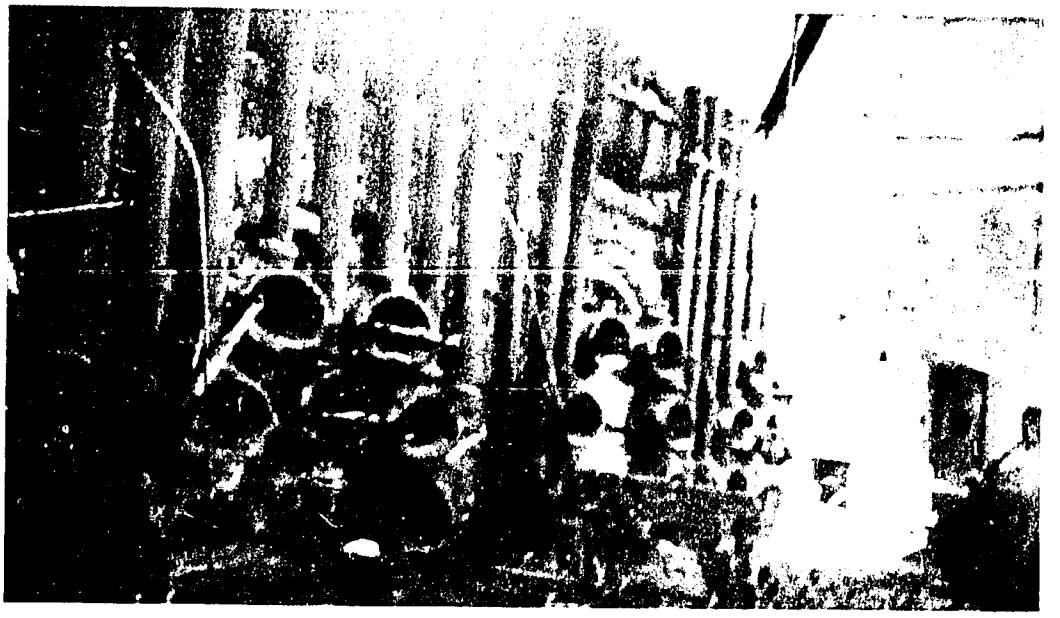
CITY OF VOLOS
VOLOS GREECE
GAS DEPARTMENT



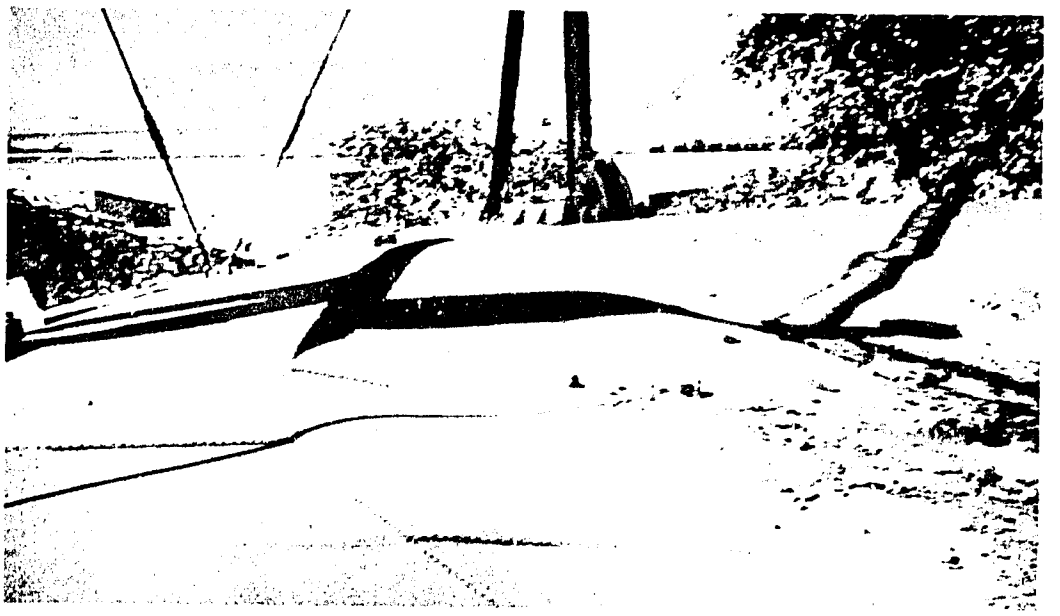
Retort Stack
Damaged By Bombs;
In Danger of Falling

Scrubber
and
Condenser

CITY OF VOLOS
VOLOS GREECE
GAS DEPARTMENT



View of Horizontal Retorts - Bad Condition



View Showing Seam Rip in Holder